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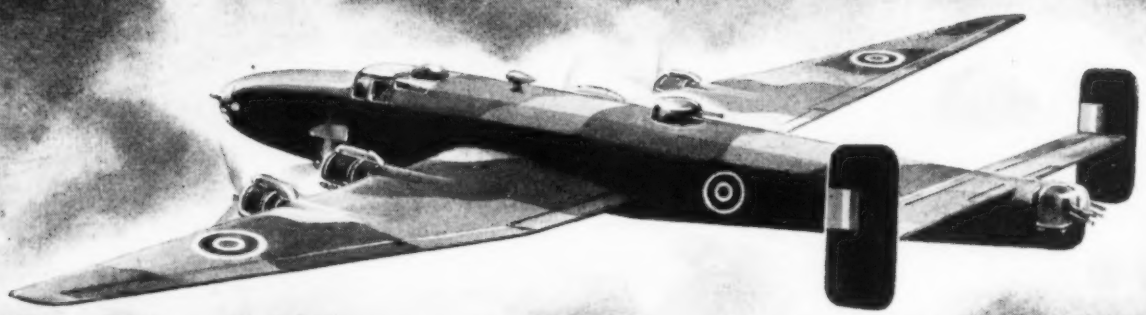

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FLIGHT
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The AIRCRAFT ENGINEER

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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C. M. POULSEN

Managing Editor
G. GEOFFREY SMITH, M.B.E.

Chief Photographer
JOHN YOXALL

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The Outlook

Ars Longa : Vita Brevis

AT the Battle of Waterloo some 62,000 men were killed or wounded, 15,000 of them British. Britain rejoiced at the victory, but deeply mourned her losses. Yet, had Waterloo not been fought, none of those thousands of men would be alive to-day. The cause for which they fought, however, still lives, and we are fighting for it again to-day.

These reflections are prompted by the destruction of the Monastery on Monte Cassino, and the discussion which it has provoked as to the comparative value of men's lives and works of art—using art in the widest sense of the word to include all that makes for the spiritual side of civilisation.

It is unfortunate that the controversy has been narrowed down to these limits, and that the question has been asked: Would mothers consent that their sons should lose their lives to preserve certain erections of stones, pieces of painted canvas, or inscribed vellum and printed papers? Put in that way, the answer could hardly be anything but a negative. Yet one cannot preserve men's lives; one can only prolong them. The great works of art and of thought are of priceless value to generation after generation. The Monastery on Monte Cassino is not in the highest category of works of art, but many other treasures which are invaluable have been in danger during the present war, and some may yet be destroyed. It behoves us to think how their loss will grieve future generations when the very names of the men now fighting will have been forgotten. All later ages have been the poorer for the burning of the library at Alexandria in Roman times.

One can, in fact, imagine circumstances in which civilised men would feel it necessary to fight a battle to preserve important works of art, counting their own lives as less important than the treasures they died to save. It was in that spirit that martyrs died for their religion. The comparison is fair, although religion is not a work of art, but it is one of the spiritual factors of life.

In the present war the United Nations are fighting for a spiritual cause, and that cause is greater than any manifestation in stone, painted canvas or paper of art or spirit. For such a cause the lives of fighting men have to be sacrificed. In other circumstances, as we have suggested, it might be legitimate to sacrifice lives to save a library or a cathedral. But in this war we must put first things first. Some battles (but not all) are so vital that no sacrifice either of lives or of artistic treasures must be spared in order to avoid defeat. It is tragic to have to shorten lives; it is deplorable to deprive our own age and future ages of things which the spirit treasures. In spite of regrets, nothing must hold back our hands from the task of defeating the enemies of freedom.

The Flying-boat Argument

SOME rather curious arguments are, it appears to us, advanced by the author of this week's article on the flying boat and its future. He endeavours to answer, and in some cases to refute, challenges and claims made by flying-boat advocates, but not always with unassailable logic. We have no authorisation to take up the cudgels on behalf of such authorities as Gouge, Knowler and Kemp, who are quite capable of stating their own case, but there are certain arguments which appear to call for elucidation.

For example, the fact that Coastal Command uses but three flying-boat types as against nine types of landplane does not prove anything much except that there were many more landplanes available, these having been originally designed for other work.

On the vexed question of forced landings at sea, the

author of this week's article quotes the many cases in which landplanes have alighted on the sea and, because of their pneumatic flotation gear, remained afloat so long that they had to be sunk by naval gun fire. The obvious retort seems to be similar gear in flying boats.

The effect of fogs would appear likely to be much the same whether the aircraft is a landplane or a flying boat, with the exception that the boat can, should it be unavoidable, alight outside the fog area and taxi in. There was actually a case of an Imperial Airways flying boat landing some miles outside the Isle of Wight and taxying up to its base in Southampton Water.

On the relative costs of laying out and maintaining airports and seadromes we are not qualified to argue. But it might be pointed out, in connection with Mr. Pollitt's reference to existing air stations and their runways, that not one of them is capable of use by the "Hundred-tonner or Larger" of the post-war period. And it is in such sizes that the flying boat begins particularly to come into the picture.

There are other aspects of the argument which might be taken up, but probably some of our readers will have something to contribute to this interesting discussion.

Truk

A NAVAL action is always followed by a period of wireless silence, and the world has to possess its soul in patience before it is able to learn the full details. Whatever those may ultimately prove to be, it is news of first-rate importance that the American Navy should have been able to follow up its successful attack on the Marshall Islands with such an immediate attack on distant Truk in the Carolines. The United States is showing that it is not daunted by the great distances of the Pacific Ocean.

The attack, as was to be expected, was carried out by a bombardment by the guns of the warships and a tremendous bombing by aircraft from the accompanying carriers. Truk has always been a place of mystery. It is known to be the chief Japanese naval base to the south of the islands of Nippon, and it has been generally supposed that the Japanese battle fleet was using it much as the British Grand Fleet in the last war used Scapa Flow.

A battle fleet does not need to be always on the move, though action is good for the crews, and inaction saps their fighting spirit. By remaining in being, a battle fleet protects the cruisers, carriers and other vessels which move on the seas in the vicinity; were it not there the opposing battleships could fall upon those warships and their convoys.

Japan's strength in battleships is a secret which has been carefully kept, but it cannot conceivably equal, or even approach, the combined strength of the United States and Britain. It must now be a major object of the Allies to tempt the Japanese Admirals to a full-scale trial of strength. This first attack must have provided the Americans with a lot of information (the aircraft would gather that), it must have seriously damaged the base, it has still further reduced the enemy's strength in cruisers, other vessels and aircraft, and it must have given a severe shock to the enemy's High Command.

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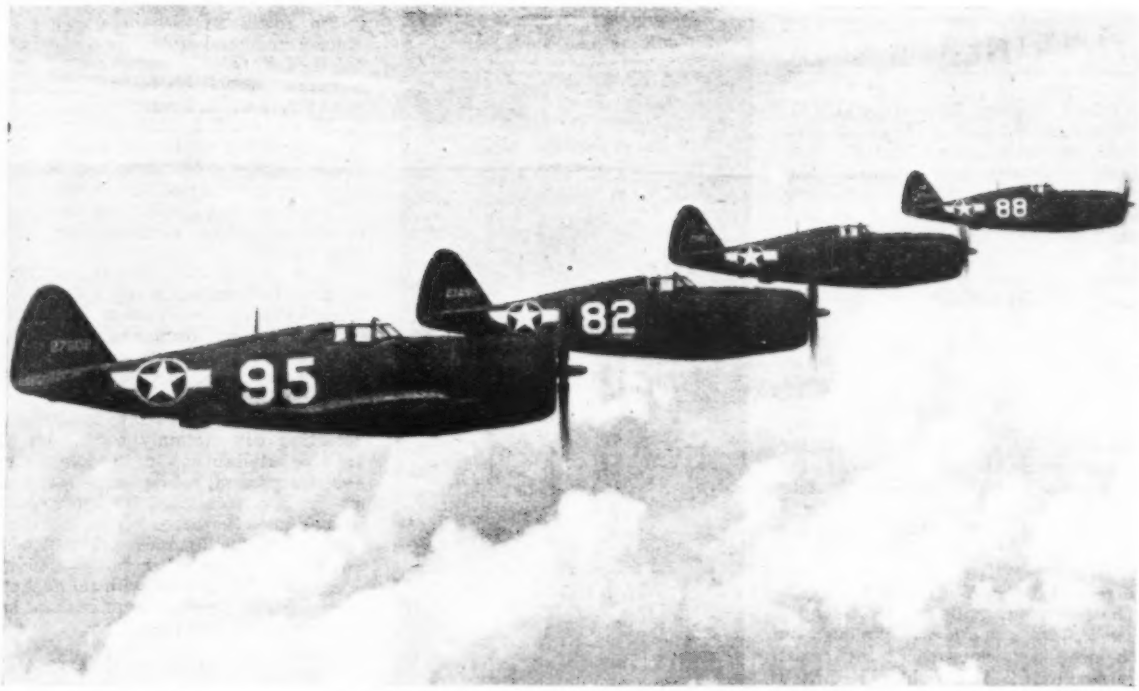
GLOBE TROTTER: An Avro York belonging to British Overseas Airways Corporation. Some interior photographs appear on page 201.



IN NEW WARPAINT: Long-range Thunderbolts operating with the "strat" force in the Mediterranean. Note the absence of the usual white identification stripes.

WAR in the AIR

Monte Cassino Monastery Bombed at Last: Success of Escort Carriers: U.S. Fleet and Naval Aircraft Attack Truk Naval Base

AFTER all, the Allies were obliged to destroy the Monastery on Monte Cassino. It would appear that the Germans had not expected them to do that, as they had not fortified the place with many A.A. guns. Fortresses of the U.S. 15th Army Air Force made the first attack, and their bombs blew the place apart like a house of cards, leaving a blazing inferno inside. Then, as the Germans ran out and scattered, the artillery opened up on them with anti-personnel shells, which apparently have taken the place of shrapnel as man-killers. No monks were seen to be escaping from the ruins, so it is supposed that they had all departed at an earlier stage. Incidentally, the leaflets warning all Italians to leave the vicinity were not dropped from aircraft but were also sent over by the guns in what were described as air-blast shells.

General Alexander seems to have given the Press correspondents in Italy a severe talking to, for having, as he alleged, sent home alarmist reports about the prospects on the Anzio beachhead which he had just visited. He said that we had won the first round of that battle, were in the course of winning the second round, and that the third round would come when we had gathered our forces. If it is a fact, as has been reported, that the landing has drawn against it far more German divisions than the Allies have deployed, one may begin to see the purpose behind the tactics used.

This brings us to the fact that the Germans move their divisions almost entirely by night and on the roads, and that in turn draws attention to the small scale of our night bombing. There is a force of Wellingtons in the Mediterranean which works by night, and it has not received all the praise to which it is entitled. It has been working very hard. All the same, it is evidently not strong enough to act as a major deterrent to the German movements, and one wonders if there is any local reason why more night-bombers are not sent for and employed there. One realises that winding a way by night among cloud-covered mountains is not good practice, but one also questions whether such risky proceedings are the only way of hitting at traffic on the roads behind the German lines.

The Fleet Air Arm has gained further laurels in a recent battle round a convoy. Seven German bombers, including He 177s and Fw 200s, attempted to attack the convoy about

TRIPPERS RETURN: R.A.F. Spitfires return to base after a patrol over the Anzio beaches.

WAR IN THE AIR

dusk one evening. The carrier H.M.S. *Pursuer* formed part of the escort, and probably the Germans thought that its fighters would not venture to take off in the failing light. Of course the fighter pilots accepted the risk, and four Grumman Wildcats flew off. They were outnumbered, but still they held the trump cards in their hands. A heavy bomber far out over the ocean stands a very poor chance of survival if seriously damaged, while the fighters had their carrier at hand as well as the friendly ships of the convoy to pick them up if they came down in the water. Consequently German heavy bombers never show much stomach for a fight when tackled by fighters far from shore. The Wildcats (lately known in the F.A.A. as Martlets) broke up the German attack and drove the bombers off. One Heinkel and one Focke-Wulf were shot down and a second Focke-Wulf was damaged. The other four made off, and then all the Wildcats made safe landings on the not too spacious deck of the escort carrier in the bad light. It was a gallant and most successful little show.

A subsequent success by Wildcats from H.M.S. *Biter* has also been reported. In this case one Ju 200 equipped with a glider bomb tried to attack a convoy in the North Atlantic, but the carrier sent up two Wildcats, and the enemy at once tried to get into a cloud. He had nearly succeeded when the fighters were able to open fire. They shot away one of the Junkers' starboard engines, and the bomber promptly crashed in flames. Then both the fighters successfully landed on the flight deck of the carrier. Later in the same day a Coastal Command Beaufighter, which was then taking part in the escort duties over the same convoy, shot down another Ju 200.

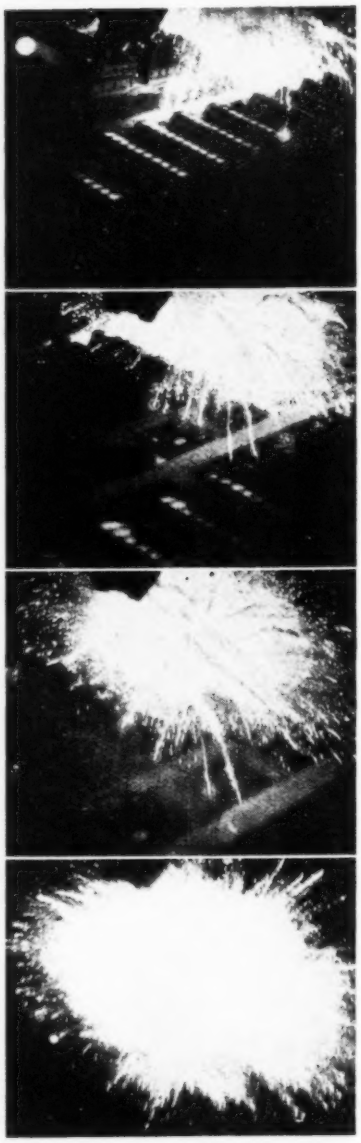
The Anzio Battle

KESSELRING made another grand assault on the beachhead at Anzio on February 16th, using a formidable concentration of artillery, and actually venturing to make 130 aircraft sorties against the troops on the enclave. The weather had improved, and so both sides were able to make more use of the air, and this fact told in favour of the Allies. Kesselring is a *Luftwaffe* Field Marshal, and appreciated the importance of not allowing the Allies a monopoly of air power, especially over the flat ground round the beach. Up in the Apennines air power has less value.

In reply Gen. Eaker used all the resources at his command to hit the assaulting Germans hard. Again the Fortresses and Liberators of the U.S. Army 15th Air Force were used for tactical action, and they were suitably armed for the task in hand. They did not carry the high explosive bombs which are intended for destroying buildings, but dropped some 1,000 fragmentation bombs, which are essentially man-killers. There were nearly twice as many American heavy bombers in the sky as there had been over Salerno on September 14th. Medium bombers also attacked the German back areas with the object of preventing supplies and reinforcements from reaching the firing line; and railway lines, yards and bridges were also attacked, with special attention to the neighbourhood of Florence.

The Middle East Air Command is being deprived of the American Army 9th Air Force, which is to join the invasion forces in Britain under the general command of Air Chief Marshal Leigh Mallory. It includes medium bombers, attack bombers, fighter-bombers, and fighters. Throughout the Libyan campaign this force worked in conjunction with the Desert Air Force. Now the Mediterranean Allied Air Force is strong enough to dispense with the 9th A.F., while the invasion command needs overwhelming air strength.

It is a matter for speculation whether this move has any connection with the recent departure of the Allied military mission from Turkey. If it has, it may mean that there is now thought to be less urgency in dealing with the Aegean Sea and the Dodecanese Islands. Their turn for serious attention will certainly come, but it may be advisable to leave them alone for the present, while maximum air power is concentrated for more vital operations elsewhere. The invasion force certainly deserves and demands priority over all other fronts, and it is receiving it, though with no neglect of the Italian front—except perhaps in the matter of night bombers.



PUTTING IT ON THE SPOT: A sequence of photographs showing a target indicator bomb falling on the Gnome-Rhone engine factory at Limoges, 200 miles south west of Paris.

The Solomons and Truk

NO less than 22,000 Japanese soldiers have been cut off in the Solomons and are facing extermination, chiefly from famine and disease. After American forces had occupied the Green Islands, 120 miles to the east of Rabaul, which they did with only slight opposition on the ground and in the air, Gen. MacArthur announced that for all strategic military purposes the campaign in the Solomons had been completed. That means that the advance will be continued, and Rabaul is now in serious danger. The bombing of that base has continued, and we all look forward to the day when the place will be occupied by Allied forces.

The U.S. naval forces which have seized the Marshall Islands have sent an air force to attack Ponape, an island about 400 miles east of Truk, the Japanese naval base in the Carolines.

Next—and this is one of the biggest pieces of news which has come in for a long time—the U.S. Navy has reached the Japanese naval base of Truk and attacked it. Powerful naval forces arrived there at daylight on the morning of February 15th. They had several hundred aircraft working with them, which implies a strong force of carriers. That is where the Japanese battle fleet has been believed to have been waiting, covering by its presence there the movements of cruisers and other craft as they escorted supply ships and transports full of troops to the various lands which the Japanese overran in their first fine flush of victory after the treacherous attack on Pearl Harbour. They little knew then what a hornet's nest they were stirring up for themselves! They thought that they had crippled for good and all the sea power of the United States, while Britain seemed to their heated imagi-

EVEN I CAN UNDERSTAND—17.

Q. *How is lift obtained from a moving aerofoil?*

A. The pressure in a fluid becomes smaller when it is in motion relative to its surroundings. Familiar illustrations are the suction exerted by a scent spray or the lowered pressure in the choke of a carburetter. It was Bernoulli in 1738 who reduced this phenomenon to law and order in his well-known Theorem. This may be rather crudely stated by saying that when part of a mass of fluid is flowing steadily and therefore has energy of movement (proportional to mass per second x velocity^2) the pressure in it will go down to such an extent that the energy of movement or kinetic energy added to the pressure is the same in any part of the fluid, still or moving. (It may seem odd to add a pressure to a quantity of energy. It must be remembered that pressure is potential energy and the two forms can be converted into one another.) If there is no movement the pressure will be greatest (generally known as "total head"). If movement starts the kinetic energy must be deducted from the total head to get the pressure in the moving stream. The immediate means by which lift is imparted to a wing, and which cause the larger movements—already described (No. 8, Induced Drag)—depend on this principle. In Figs. 1 and 2 the well-known venturi meter is shown as it gives a very clear picture of Bernoulli's Theorem at work. If the end of the pipe is closed with no flow, both pressure gauges will show the same reading—the "total head" which depends on the height of the reservoir supplying it. If the water is allowed to flow both gauges

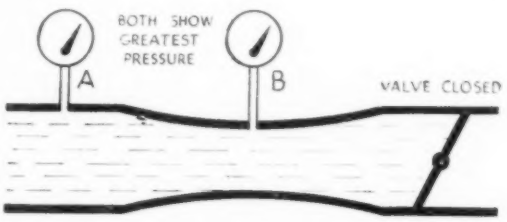


Fig. 1.—Flow stopped. Both gauges show the total head less the kinetic energy of stream (which in this case is nothing)

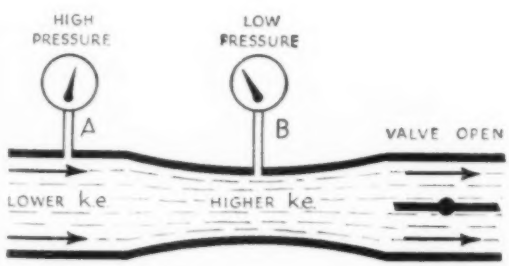


Fig. 2.—Fluid Flowing

will show less pressure but that at B less than A owing to the higher speed. The same amount of water passes all sections and as the area of the throat is less than that of the pipe the speed will be higher and the pressure correspondingly lower. It is clear that the greater the difference of pressure between A and B, the greater the flow. The difference of pressure is therefore a measure of the flow of water. The fact that pressure decreases as speed increases can be very simply shown as in the experiments illustrated in Figs. 3 and 4.

In connection with aerofoils, such expressions as "partial vacuum" are often heard. It is important to realise that up to near the speed of sound—say, 700 m.p.h., air in steady flow does not alter in density at all—behaves as an incompressible fluid like water and is subject to the same laws.

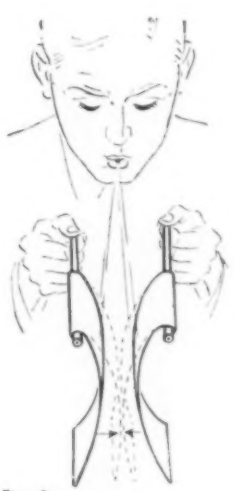


Fig. 3
If two pieces of card are curved and supported on pencils as shown, they will be drawn together when air is blown between them, because the pressure between the cards becomes less than that outside.

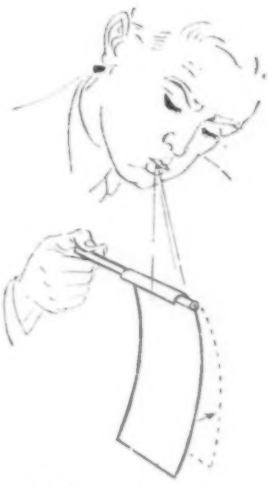
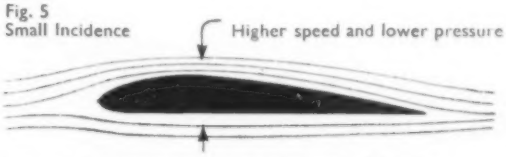


Fig. 4
One card held on a pencil resembles an aerofoil section. Air blown on to leading edge will cause it to 'lift' as shown by the dotted line.

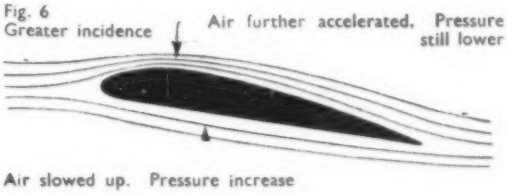
In Figs. 5 and 6 an aerofoil section is shown with the air streaming past. That part of the air which takes the longer path over the top surface and joins the part going under the wing at the trailing edge must necessarily go faster. Kinetic energy increases and pressure drops. Underneath the wing there is a smaller increase of speed and so a smaller decrease of pressure, the net result being a lower pressure on the top than the bottom of the section and therefore a lifting force. If the incidence is increased the speed and pressure drop over the top surface increases, while the speed over the bottom surface decreases and may become less than the surrounding air, thus giving rise to an increase of pressure. These conditions cause an increase of lifting force.

Fig. 5
Small Incidence



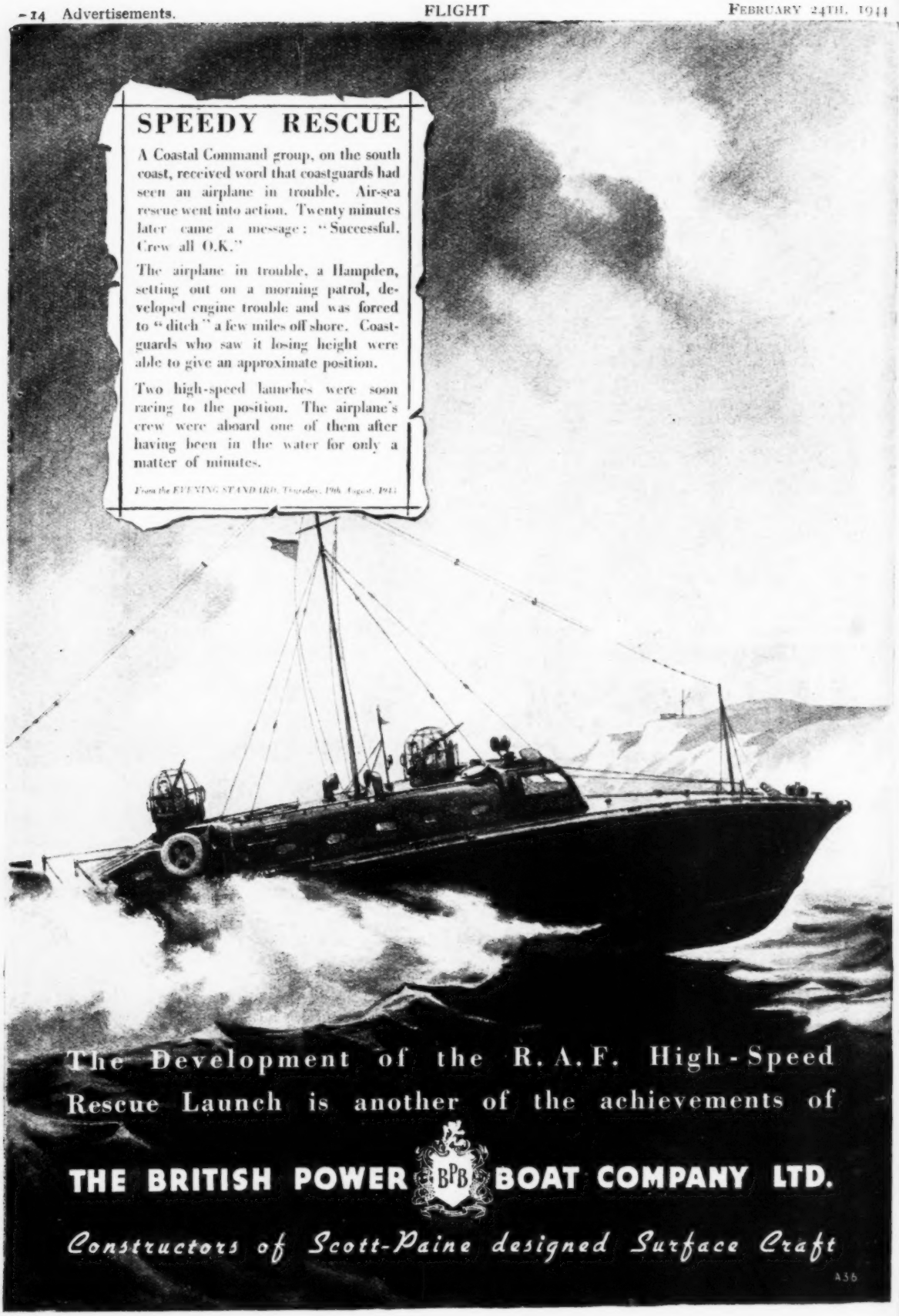
Little or no speed increase. Small change of pressure

Fig. 6
Greater incidence



Air slowed up. Pressure increase

This is one of a series of articles on technicalities sponsored by The de Havilland Aircraft Co., Ltd., in the belief that they will prove of interest and use to students and others in the Services and the aircraft industry.



SPEEDY RESCUE

A Coastal Command group, on the south coast, received word that coastguards had seen an airplane in trouble. Air-sea rescue went into action. Twenty minutes later came a message: "Successful. Crew all O.K."

The airplane in trouble, a Hampden, setting out on a morning patrol, developed engine trouble and was forced to "ditch" a few miles off shore. Coastguards who saw it losing height were able to give an approximate position.

Two high-speed launches were soon racing to the position. The airplane's crew were aboard one of them after having been in the water for only a matter of minutes.

From the EVENING STANDARD, Tuesday, 19th August, 1941.

The Development of the R.A.F. High-Speed Rescue Launch is another of the achievements of

THE BRITISH POWER BOAT COMPANY LTD.

Constructors of Scott-Paine designed Surface Craft

A36

IN CUSTODY: The arrester gear brings a Hellcat to a standstill on the flight deck of H.M.S. *Ravager*. The hook on American aircraft comes out of the extreme tip of the tail.

WAR IN THE AIR

nations to be absolutely certain to fall.

Evidently the Japanese battle fleet was not at Truk when the Americans arrived, but they sank 19 Japanese ships and destroyed 201 aircraft.

Altogether the Axis (if Germany and Japan can be so described) have had a bad time in the last week. The Russians wiped out the German 8th Army in the Dnieper bend, and in the 16 days' fighting claim to have destroyed more than 400 enemy aircraft. A force of German submarines which tried for eleven days to make their way individually through the Straits of Gibraltar into the Mediterranean was continuously engaged by naval and air forces, and three were definitely destroyed. While these operations were going on three large Allied convoys passed through the Straits without interference.

ENEMY AIR LOSSES TO FEB. 19th

	Over G.B.	Continent	Middle East	Italy
Feb. 13 ..	8	3	0	4
.. 14 ..	0	3	0	21
.. 15 ..	0	0	0	12
.. 16 ..	0	1	0	9
.. 17 ..	0	0	0	1
.. 18 ..	2	3	1	3
.. 19 ..	0	1	0	26
	10	11	1	76

Totals: West, 7,987; Middle East, over 5,820; N.W. Africa and Italy, 4,406.

In the West the Germans have made some small but vicious raids on London, but they do not compare with the mighty attacks made by the R.A.F. and the Americans on Berlin, Leipzig and other places. On the night of February 16th Bomber Command set up a new record to date by dropping over 2,500 tons of bombs on Berlin in no more than 30 minutes. That night Bomber Command had 1,000 bombers out on the raid, and during the week-end there was much laying of mines in enemy waters. On the night of the 19/20th nearly 1,000 British bombers flew over Leipzig and discharged more than 2,300 tons of bombs. Next day some 2,000 British and American bombers were out, mainly attacking fighter factories. The Americans used the largest force of heavy bombers ever sent out on a daylight mission, and their target was Leipzig, which was still writhing from the R.A.F. attack of the previous night. Gen. Arnold stated in Washington that the attack was made by 2,000 aircraft, but that would include the fighter escort.

The weight of bombs which the Americans dropped would naturally be much less than that of the same number of British heavy bombers; but if the Americans could see their targets, they may well have done vital destruction by picking out buildings which had escaped the previous night.

The British raid cost 79 machines, but the recent concentration on fighter factories must soon reduce the Germans' power of resistance in the air.

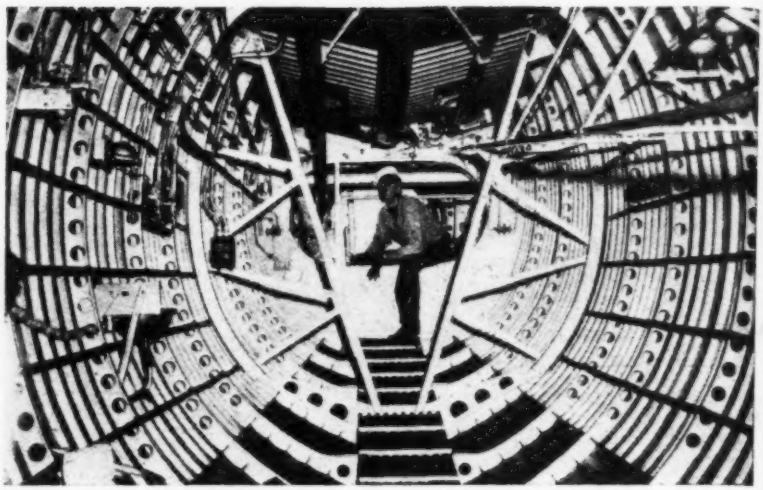
OFFENSIVE INSTALLATION: Russian mechanics fitting a wing-mounted cannon.

BRITISH & U.S. AIR LOSSES TO FEB. 19th

	Over G.B. A'cft.	Continent B'brs.	Continent F'ters.	Middle East A'cft.	Italy A'cft.
Feb.					
13	0	4	2	0	2
14	0	0	4	0	1
15	0	44	4	0	1
16	0	0	0	0	4
17	0	0	0	0	9
18	0	0	0	5	1
19	0	79	0	0	3
	0	127	10	5	21

Totals: West, 9,848; Middle East, about 2,365; N.W. Africa and Italy, 1,634.

HERE AND THERE



INSIDE INFORMATION : Looking down the tail section of the Martin Mars 170ft. hull gives a good idea of the size and type of construction employed.

Potential "Doughnuts"

NO less than 240,000 tons of rubber have been reclaimed from salvage in Great Britain since November, 1942. This is equal to a year's yield from 77,000,000 trees.

Indian Air Training Expands

THE Indian Air Training Corps scheme has just celebrated its first anniversary; it was inaugurated at Aligarh University last February.

Since then seven more universities in India have begun operations, and others are expected to adopt the scheme shortly.

Canadian Fuel

A PLANT for making 100-octane petrol will shortly be ready for production at Montreal, according to a recent statement by the Canadian Government.

This is the second plant of its kind in the Dominion, the other having not long ago been established at Calgary.

R.A.A.F. Sunderlands

SUNDERLAND squadrons of the R.A.A.F. serving in Great Britain have now flown more than 3,759,250 miles on operational duties since war began.

The first of these squadrons was formed on Boxing Day, 1940, and its personnel came to Britain to fly their boats back to Australia. But when the Australian Government decided to place the Sunderlands at Britain's disposal (and how badly we needed them!) they remained to form the nucleus of the first squadrons.

Historic Souvenir

THOSE who like to acquire historic "museum pieces" connected with aviation have a chance to add a unique specimen to their collections and help the R.A.F. Benevolent Fund at the same time.

The Fund has been given a gold pencil case which was presented to Mr. Arthur Heathfield by Mr. Santos Dumont as a token of thanks for having taught him to play bridge. With the pencil case is the letter from the famous pioneer pilot which accompanied the gift.

These are for sale to the highest bidder, and offers should be sent to the honorary secretary of the fund, Mr. Bertram T. Rumble, 1, Sloane Street, London, S.W.1, where the pencil case and letter can be seen.

FULL-TIME JOB : The flight engineer of the Martin Mars has a most impos ng array of dials and switches to look after in the world's largest flying boat now in service with the U.S. Navy in the Pacific. Powered by four 2,000 h.p. 18 cylinder Wright Cyclones, the Mars has a span of 200ft., a top speed of about 300 m.p.h., and can carry 20 tons.

"Out of Evil . . ."

"DUTCH experience in shipbuilding will enable Dutch workmen to specialise in the manufacture of very large planes after the war," states an expert writing in *Vrij Nederland*, the Dutch newspaper published in London.

"Soon," he says, "mass-production of large planes will cease and they will be built individually like ships. Dutch factories will benefit by the experience of Dutch workers who have been forced to work in German aircraft factories."

To Keep 'Em Flying

NEARLY 200 apprentices took part in a recent passing-out parade at a school of R.A.F. Technical Training Command, at which Air Marshal Sir Bertine Sutton, Air Member for Personnel, took the salute.

The best all-round apprentice, who in peacetime is presented with a sword, was 18-year-old Sgt./Apprentice A. H. Rennie, of Rainham, Kent.

Chemical Warfare

ALLIED airmen who have to bail out over the South West Pacific seas have another deadly enemy to contend with—the man-eating shark.

As protection against this extra peril they now carry a special chemical sewn into their belts which, when immersed, combines with the sea water to form an ever-spreading wall of liquid which the shark finds thoroughly obnoxious. Colouring matter is also introduced into the chemical to make the ditched airman easily visible from the air.

Something New

WHAT he described as flying "armoured freight cars" will soon be in service with the U.S. Air Transport Command operating between India and China, according to a recent statement by Major General George E. Strate-

HERE AND THERE

meyer, commander of the U.S. Air Forces in India.

"Their longer range, higher speed, and huge cargo loads," he said, "will enable us to fly important war supplies into certain areas of China which we have been unable to serve efficiently with air transport in the past."

Dive-bomber Training

A LARGE number of British pilots are now being trained in the technique of dive-bombing, using the Curtiss A-25, known in the U.S.A.A.F. as the Shrike.

This aircraft, which is the Army version of the SB2C Helldiver, is now being delivered to the R.A.A.F. as well as the U.S. Marines.

Mariners for the R.A.A.F.

A NUMBER of Martin Mariner flying boats, it is reported by *Reuter*, is to be acquired by the R.A.A.F. in addition to the Sunderlands which are being flown to the Commonwealth by Australian pilots with experience of transatlantic flying.

The Mariner, which has a span of 118ft., is powered by two 2,000 h.p. Wright double-row 18-cylinder Cyclones and is credited with a top speed of 225 m.p.h. It is fitted with power-operated gun turrets, nose dorsal and tail—and can carry two 22in. torpedoes as an alternative to its normal bomb load.

Death of R.C.A.F.'s Father

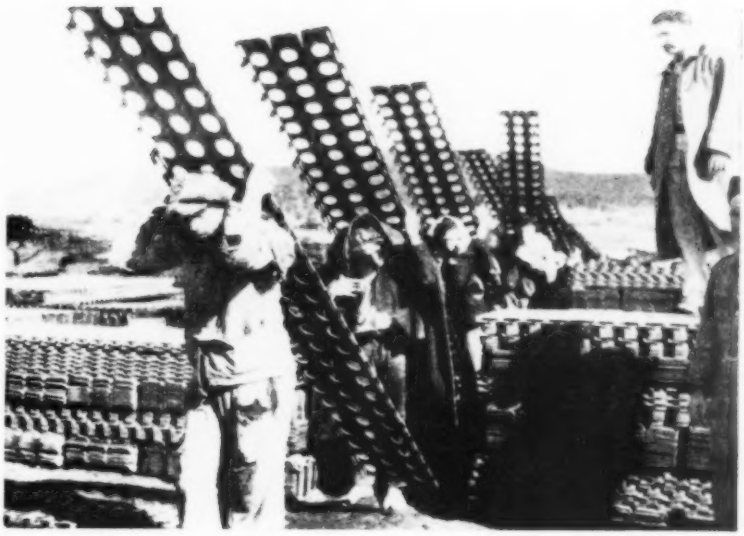
WING CDR. JOHN SCOTT WILLIAMS, M.C., A.F.C., who organised the Canadian Air Force in 1921, has died in a Montreal hospital after a long illness.

Born in Nova Scotia, he served in the R.F.C. and R.A.F. in the last war, first as an observer and then as a pilot, and after more than 1,000 hours of operational flying was given command of a flying training school in Scotland.

Round and Round

OUR recent paragraph about the "Lib" that iced-up its controls, got into a spin and clocked 350 m.p.h. before its pilot pulled out 5,000ft. lower, has provoked an "Aussie" pilot and six of his pals on a Scottish station to express their incredulity to the Editor in a manner as brief as it was emphatic; in fact they just returned the cutting with a monosyllabic observation which, but for our genial sense of humour, we might have regarded as round abuse!

Yes, Aussie, we are aware that the A.S.I. does not function properly and that no such forward speed is possible when an aircraft is in the stalled condition of a spin, but the paragraph did not say that 350 m.p.h. was recorded *during the spin*; it was in the resultant dive when the "Lib" regained flying speed, and just before the pilot levelled out; "during a drop of 5,000ft." would, you must agree, include the dive. Incidentally, the story was an official Service news item.



U-BOAT KILLERS, FOR THE USE OF: Marston runways are being used on the new airfields in the Azores from which Allied aircraft give added protection to the Atlantic convoys. Local labourers carry the metal strips during their rapid construction.

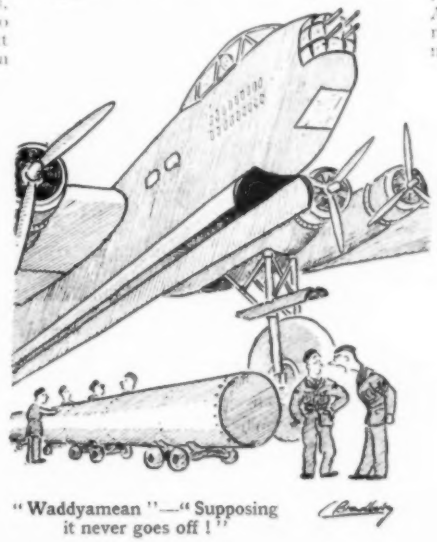
Fine Performance

A PARTICULARLY brilliant flying feat was recently put up by Capt. J. H. White, of B.O.A.C., and is duly recorded in the February issue of the corporation's *News Letter*.

Piloting a transport Mosquito, Capt. White made three journeys totalling 2,400 miles in 9 hr. flying time, and only 9¼ hr. elapsed altogether—that is, from the start of the first trip to the completion of the third.

The whole distance was flown by instruments during the hours of darkness, and as the "Mossie" in question was not fitted with a "George," Capt. White (accompanied by a radio officer/navigator) flew the aircraft himself for the entire distance.

Capt. White is 34, a native of Southampton, and joined British Airways in 1938.



"Waddyamean"—"Supposing it never goes off!"

Appointments

AIR MARSHAL SIR LESLIE GOSSAGE, Chief Commandant and Director-General of the A.T.C., has been appointed chairman of the Incorporated Soldiers', Sailors' and Airmen's Help Society.

* * *

MR. B. C. H. CROSS, D.F.C., has been appointed by the Colonial Secretary to be his adviser on air transport. Mr. Cross's services have been made available by the B.O.A.C., with whom he held the post of regional director in Central Africa.

* * *

AIR COMDRE. WILLIAM CHARLES COLMAN GELL, D.S.O., M.C., who has commanded a Balloon Group for the past two years, has been appointed A.O.C. Balloon Command and promoted Acting Air Vice-Marshal. He is the first Auxiliary Air Force officer to attain this rank and to be given an R.A.F. Command.

* * *

MAJOR-GENERAL WILLIAM O. BUTLER, U.S.A.A.F., has been appointed Deputy C.-in-C. Allied Expeditionary Air Force, under Air Chief Marshal Sir Trafford Leigh-Mallory. General Butler served in the 1st Aerial Squadron in the last war and was Commanding General of the U.S. Army and Navy Air Forces in Alaska when the Japs were driven out of the Aleutians.

* * *

"Flight" Index

FLIGHT Index for July-December, 1943, is now available, price 1s. 1½d. post free, or together with binding case at 4s. 10d., including postage. Readers' copies can be bound in the publishers' case with index for 13s. 3d., which includes postage for returning the bound volume.

D

The Flying Boat

Will it Survive : Questions of Loading, Lateral Stability and Forced Landings

By C. A. H. POLLITT

IN our issue of December 16th, 1943, Mr. Pollitt examined somewhat critically the report issued by Saunders-Roe, Ltd ("Flight," November 25th, 1943) entitled "The Case for the Flying Boat." Since then we have had the benefit of the views of such well-known flying boat experts as Mr. H. Knowler, Mr. W. P. Kemp and Mr. A. Gouge. In this article Mr. Pollitt discusses points raised by some of these contributors, and enlarges upon his previous observations.

THE controversy inspired by my recent criticism (*Flight*, December 16th, 1943) of the Saro report has thrown light on a number of interesting points and has evoked the views of some of the staunchest advocates of the flying boat who have replied with force and conviction to my seemingly provocative comments.

Much of what has been written has served to elucidate the more conflicting issues but has left other and more searching questions still unanswered, a fact perhaps best attributed to the brevity of my original criticism, in which I defined only three failings of the flying boat. Before withdrawing from the argument I would therefore like to enlarge upon and corroborate my previous observations.

At the outset: There can be no more worthy champions of the flying boat than those who have guided and impelled its development over a period of very many years. Mr. Knowler (*Flight*, January 6th, 1944), Mr. Kemp (*Flight*, January 27th, 1944), and Mr. Gouge (*Flight*, February 10th, 1944) have been conspicuously associated with the finest boats yet built, and each is intimately acquainted with the advantages, and the limitations, of the type.

On the one hand, the point is made that the prevalence of fog in the London area may justify a British terminal being remote from the Metropolis while the need for cabin pressurising is claimed to render a flying boat hull admirably suited to the purpose.

On the other hand, Mr. Kemp's inspired pronouncements are a comprehensive survey of geographical features that would favour the establishment of virtually world-wide flying boat services. He lays added emphasis on the potential worth of extensive seaboards, of sheltered lakes and convenient rivers, all of which I agree are valuable assets. But this is not true judgment: latent geographical potentialities will not improve the flying boat as a commercial transport.

And then we have Mr. P. J. Edmunds' letter in the issue of January 13th. This constitutes a breakaway into the sphere of the amphibian in an endeavour to put the flying boat on an equal footing with the landplane in so far as coast-to-coast transport is concerned.

Combined with these arguments there is the point made in the original Saro report that "... in spite of the special importance of the flying boat to the maritime peoples of the British Commonwealth, there is a danger that it will not be given its proper place in the programme of development for the future."

Looking Back

If experience demonstrates an inherent disadvantage, then the past four years of Service aviation have indeed produced illuminating evidence of the total inadequacy of the flying boat as a load-carrying medium.

Coastal Command shares as close an affinity with the sea as almost any other branch of the service, with the possible exception of the Fleet Air Arm, yet Coastal Command employ only three flying-boat types as against nine types of landplane. (See table.)

Then again: Of the considerable fleet of aircraft operated by British Overseas Airways—whose title and function

COASTAL COMMAND AIRCRAFT

Flying Boats	Landplanes	
Catalina	Liberator	Hampden
Sunderland	Beaufighter	Wellington
Lerwick	Fortress	Halifax
	Hudson	Manchester
	Ventura	

are surely synonymous with the purpose of the flying boat—only 25 per cent. or so *are* flying boats. The answer to this is easy, because the success of the flying boat is contingent upon special conditions. In the first place, if anything other than personnel is to be carried, the most convenient place to stow it is under the wing. For small bombs, depth charges, or what-have-you this is an acceptable expedient, but if the cargo be heavy freight or merchandise it can only be loaded through hatches in the top of the hull, and one has visions of floating cranes and barges, etc., etc., as in Fig. 1, contributing to make the whole business as difficult and complicated as ever. I submit that no scheme can be evolved for loading a flying boat with the ease and facility of a landplane.

My considered opinion is that these facts explain the apprehension that future development may overlook the flying boat and are a pointer to past indifference to the type.

Those Forced Landings

Let us look at the evolution of the flying boat from first principles: It has been said that the flying boat is the result of the impact of aeronautical experience on the marine mind, and that despite the technical excellence of the modern flying boat, it is a fact that in any flying-

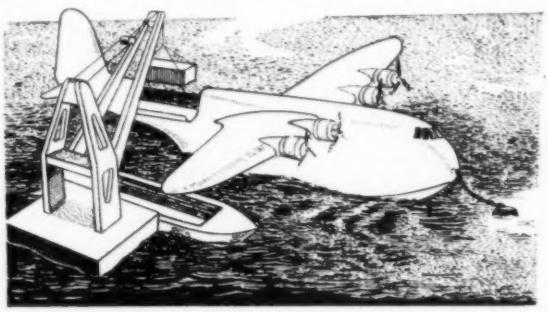


Fig. 1. The author's idea of the sort of cumbersome loading arrangement we might have to use.

boat design a balance must be struck between the conflicting requirements of aerodynamic efficiency and seaworthiness.

In this light the flying boat is presented as a compromise in which aerodynamic efficiency is to some extent subordinated to equally urgent practical requirements. As an example, consider the retracting wing-tip float. This is

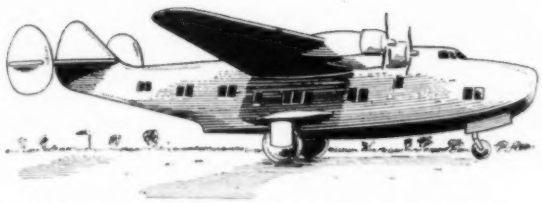


Fig. 2. **Amphibian flying boat based upon the suggestion of a contributor to our Correspondence page.**

regarded as a refinement, yet it still remains an encumbrance with a known capacity for wallowing, and when retracted it becomes but a second-rate wing tip devoid of any purity of form.

For my own part I am essentially unprejudiced, and I hold no brief for the landplane, but I am also not convinced that the flying boat is the exclusive answer to transoceanic air transport. My views are based on observations going back to 1934 or so. At that time *Deutsche Luft Hansa* were operating Dornier "Wal" flying boats on the South Atlantic service between Bathurst and Natal, and during a period of two or three years it was only necessary to make three forced landings at sea.

In the ten years intervening, engine maintenance, overhaul, and in consequence reliability, have improved to such an extent that I believe this record could be improved upon and the possibility of a forced landing almost discounted. Perhaps I am a little too optimistic, so for the moment I will accept Mr. Edmunds' sober warning to consider the psychological effects of a forced landing at sea.

First of all, we must realise there is a danger that the false perspective encouraged by persistent claims of the flying boat having a ready-made landing surface may prove misleading, and this goes for the forced-landing bogy also.

In their comments on this point Mr. Kemp and Mr. Edmunds very aptly acknowledge the possibility of bad weather interfering with the process, and I am brought to wonder if it is realised what serious limitations are thereby implied. In certain parts of the globe the safety factor of the flying boat, i.e., its ability to land on water, is of little consequence and it is on a par with the landplane. I should certainly be very apprehensive at the prospects of a flying boat forced to land in the Mediterranean with a mistral blowing; which serves to confirm my memory that off the West Coast of America the Pacific swell will produce 30ft. waves without there being any wind. *Some* "ready-made" surface!

Moreover, the difficulty of clearing a seadrome of drifting, and possibly submerged, iceflows would be a greater problem than clearing the concrete runways of a snow-bound airport. Putting the matter in a nutshell, an airport is statically determinate; a seadrome is not.

Perhaps I may be permitted a guarded reference to what is surely the classic example of the landplane's aquatic aptitude. The well informed will recall that during this war certain of our bombers whose duties exposed them to long sea crossings were fitted with pneumatic flotation gear as a precautionary emergency measure. The purpose of this equipment was to keep the machine afloat long enough for the crew to abandon aircraft in the event of a landing at sea. There can be no finer testimony to the success of the idea than those reports which reveal that many of these aircraft, after having been abandoned for hours, had to be finally sunk by naval gunfire.

Here is the moral. With a heavy sea running a forced landing might tear the bottom out of a flying boat, and with subsequently fatal consequences. A landplane with carefully placed flotation gear could possibly suffer similar damage and still not founder.

Post-war Instrumentation

What Mr. Knowler argues in regard to the effects of fog is, in the main, highly debatable. One must confess to batting on a sticky wicket when holding forth on the possibilities of post-war instrumentation for so much of its present development is correlative with military procedure and therefore highly secret.

The view I take is that if seven or eight hundred aircraft can rendezvous over a certain area of enemy territory, within the space of thirty minutes or so and in infinitely hazardous conditions, then modern instrumentation should ensure bringing a mere handful of, say, fifteen or twenty civil aircraft safely into a fog-bound airport. I make this assertion without any knowledge of the collision risks on these big raids but with the firm conviction that we have, even now, almost mastered the paralysis of fog.

To compare a fog-delayed train service with a similarly handicapped air service is no criterion at all, for the two are worlds apart. A train can move only in one direction and in one plane and when brought to a standstill it will

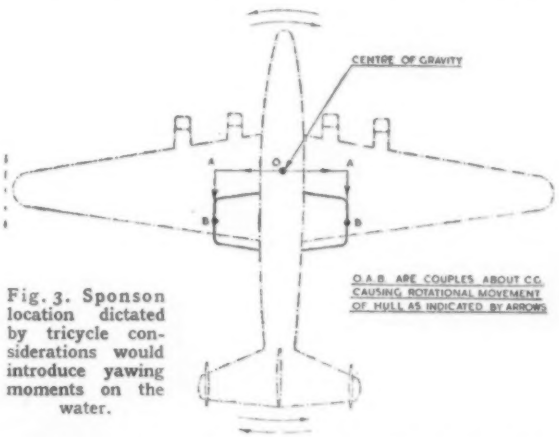


Fig. 3. **Sponson location dictated by tricycle considerations would introduce yawing moments on the water.**

inevitably cause a hold-up for two or three miles down the line. Such a bottleneck can hardly occur with a number of aircraft stepped-up at various altitudes.

Regarding Mr. Edmunds' proposal, which I have sketched in Fig. 2, the whole idea is fundamentally at variance with recognised practice and, far from having any saving grace, is actually full of loopholes. The first thing to be observed is that the fore-and-aft location of the sponsons is immediately affected, which is what Mr. Edmunds predicted. On dry land the machine would probably be safe enough, but in the water a very different state of affairs would prevail and the machine would be hard to handle. Obviously under the influence of moments

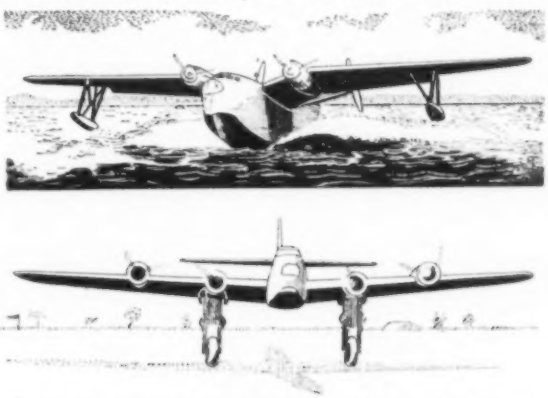


Fig. 4. **Comparative lateral stabilities of boat and landplane at moment of touching down are determined by hull beam and wheel track.**

about the c.g. caused by the rearward disposition of the sponsons, the boat would have a pronounced tendency to yaw, as shown in Fig. 3.

The great failing of the amphibian, however, is contained in the fact of it incorporating two landing devices, and if

THE FLYING BOAT

the salvation of the flying boat is to be resolved into such an elaborate scheme, I fear the continued decline of the type is assured.

The need for unusually high strength factors, generally attained at the expense of performance, is another drawback of the flying boat. In the past criticism has been levelled at the U.S. Navy's predilection for flying boats that were able to land in a choppy sea with four- or five-foot waves. Here the critics have maintained that this consideration unduly impairs the cargo capacity of a boat since it involved too many bulkheads. By way of parenthesis one might add that four-or five-foot waves are no exception to the rule.

My final observation adverts to an inherent and, so far, ineradicable failing of the flying boat. It is a generally known fact that all flying boats are laterally unstable as the result of having a negative metacentric height. To counter this, wing-tip floats and sponsons are used, both of which only serve their purpose when the boat is at rest. During take-off or landing, lateral stability is a function of the beam of the hull, whereas the landplane has an undercarriage whose track may be two or three times this beam. In Fig. 4 I have endeavoured to illustrate this point by showing a flying boat and a landplane, each at the moment of touchdown.

When he addressed the London Association of Engineers on February 5th, Mr. Gouge was soberly confident that the major disadvantages of flying boats would diminish as their sizes increased. This is perfectly true and providing improvements appropriate to such increased sizes are duly forthcoming there is good reason to believe that the 100-ton flying boat may draw abreast of a similar landplane. Such refinements as a faired main step may go far towards ensuring this, and retractable steps or chines may be a more commendable enterprise than I am willing to admit. So much depends on the methods employed.

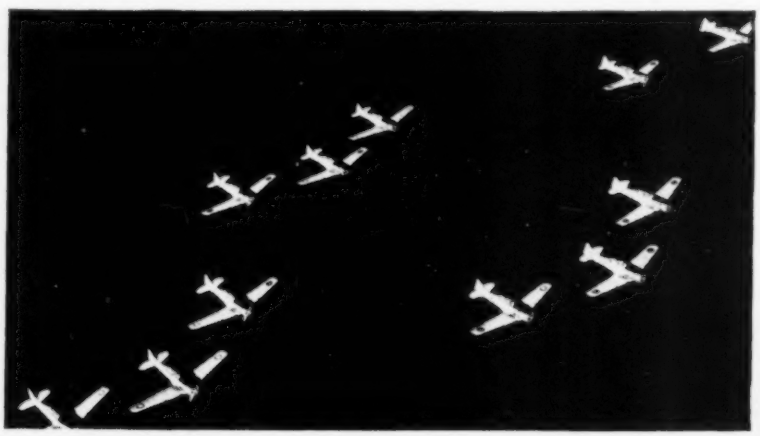
Cost of Bases

I am afraid I don't see eye to eye with Mr. Gouge in so far as capital outlay for landing facilities is concerned. Whether we use landplanes, flying boats, or amphibians, we are going to need large and expensive bases: The point which most people miss is that we already have several hundred heavy bomber stations up and down the country, each with long and wide concrete runways. Why incur the additional expense of flying boat bases?

Like the rest of us, Mr. Gouge is sceptical of with what degree of safety a landplane could be put down away from its base, where there are no concrete runways. Reflecting on this point, and making convenient assumptions, I have come to the conclusion that a long-range passenger aircraft of 150,000 lb. gross weight, cruising at not more than 200 m.p.h. for a range of 3,000 miles, would be disposing of fuel and oil at the approximate rate of 2,500 lb. per hour. At the conclusion of a 3,000-mile flight it would be the lighter by 37,500 lb., and throughout the flight its weight would be consistently and proportionately diminishing. In the light of these facts I think the chances of a machine safely surviving a landing away from its base are evenly divided.

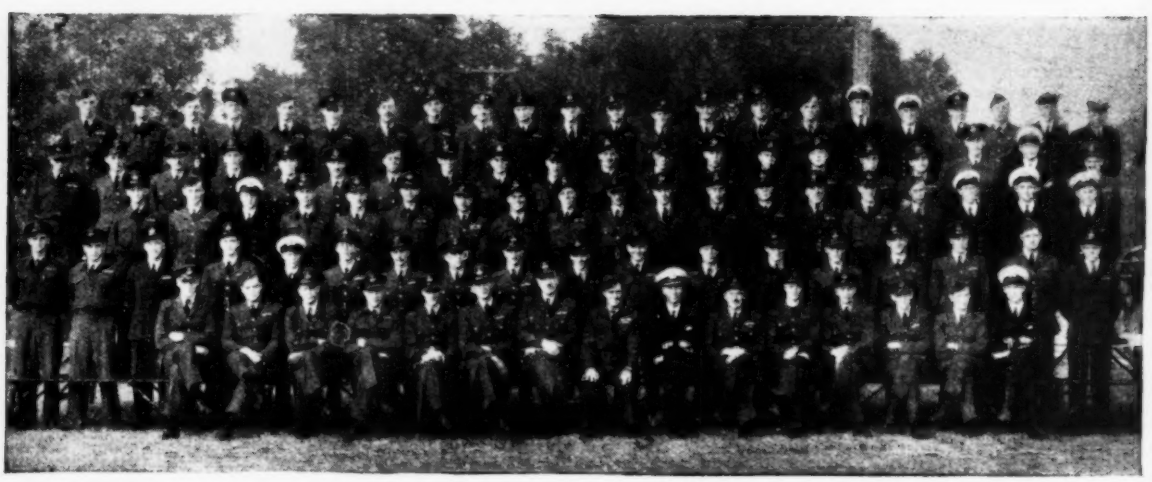
F.A.A. TRAINING IN CANADA

UNTIL recently air pilots of the Royal Navy received their elementary flying training in England. The Fleet Air Arm now has two elementary and one service flying training schools in Canada. The S.F.T.S. is at Kingston on the shores of Lake Ontario, and is one of the few schools not situated on the prairies. Kingston was the first R.A.F. training station in Canada under the Commonwealth Air Training Plan.



(Right) North American Harvards from No. 31 S.F.T.S. in squadron formation over the waters of Lake Ontario.

(Below) The officers of No. 31 S.F.T.S. at Kingston, Ontario.



B.T.H. and the Jet

British Manufacturer's Share in Development

IT has already been mentioned in these columns that in the development of the turbine-compressor power plant for his jet propulsion system Grp. Capt. Frank Whittle, R.A.F., was able to draw on the accumulated experience and manufacturing skill of the British Thomson-Houston Co., Ltd. A brief account of this collaboration, resulting in the successful plant which advanced jet propulsion of aircraft from theory and experiment to practical operation, can now be disclosed.

The Company was first approached by Grp. Capt. Whittle in September, 1931, in connection with a paper he was preparing on "The Turbo Compressor and Supercharging of Aero Engines" for the Journal of the Royal Aeronautical Society. In view of the Company's experience with turbo compressors and superchargers operating at high speeds, they were able to furnish certain data which were incorporated in this paper.

During 1933 the B.T.H. Co. carried out a comprehensive investigation of the possibilities of various gas turbine cycles from the point of view of the use of this type of prime mover for generating power.

In January, 1936, Grp. Capt. Whittle contacted the B.T.H. Co. in regard to the development of a jet propulsion plant for aircraft. The Company had gained experience in the manufacture and operation of the 10,000-kW steam turbo-alternator which they supplied to the Detroit Edison Co., U.S.A. The turbine of this aggregate had successfully operated in commercial service at an initial temperature of 538 deg. C., and as a result the Company had available information as to materials which would probably stand up to the stresses to be met in an aircraft propulsion unit. In view of this, and their long experience in building high-speed turbines and compressors, B.T.H. decided to collaborate and an order for the first experimental unit was placed by Power Jets, Ltd.

In this design air is drawn into the compressor, compressed, heated by the combustion of injected liquid fuel, partially expanded in the turbine wheel which drives the compressor, and expelled through an exhaust pipe to provide the propulsive thrust by reaction. The first propulsion unit was completed and run on a test held in April, 1937.

As was to be expected, several defects were revealed and extensive modifications were carried out in the design. Further plants were built by the B.T.H. Co. incorporating various improvements which experience on the test bed had shown to be necessary. Gradually, difficulties inherent in such a development were overcome; a plant was installed in a monoplane built by the Gloster Aircraft Co., Ltd., and successfully flown for the first time in May, 1941.

A similar plant manufactured by the B.T.H. Co. was sent to their associated company in the U.S.A.—the General Electric Company—in September, 1941, after information regarding the development had been disclosed in July of that year to General Arnold, of the U.S.A.A.F.

EMPIRE AIR TRAINING CUT FORECAST

MR. CHARLES GAVAN POWER, Canadian Air Minister, told the Canadian House of Commons recently that from now on there must be "contraction and not expansion" in the British Commonwealth air training plan.

He was answering a question put by Flt. Lt. James Sinclair, M.P., about the recent retirements of several high Air Force officers.

It was necessary, he said, that there should be no bottleneck at the top of the Air Force, and his Department had adopted a "definite retirement policy."

There could not be a stagnation at the top of the Service in which so many young and able men were earning promotion. The young men had been shown that there was "room at the top."

There was no stigma or reproach in the retirement of senior officers, but it was a "ruthless necessity if the Royal Canadian Air Force was to continue in the war and afterwards to be the young dynamic organisation we all want it to be."

Mr. Power told the Commons there was a conference in Ottawa between the Canadian Air Ministry and Capt. Harold Balfour and the British Air Ministry to bring about "better conditions of service for our R.C.A.F. men overseas."

General Eisenhower talking to officers in the ante-room during a visit to the R.A.F. Staff College. Air Vice-Marshal C. E. H. Medhurst, Commandant of the college, is on his left.

Turbo Supercharging

Details of the G.E.C. Unit : The Benefit of Exhaust Turbo-superchargers

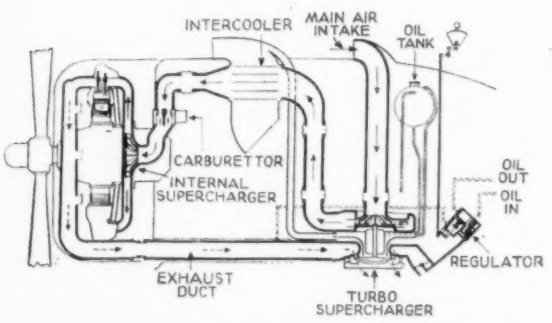
AS is well known, the object of a supercharger is to supply an artificial sea level atmosphere to the engine in order to maintain the rated power at high altitudes. Most British superchargers on standard types of engines are mechanically driven and have one- or two-speed gear drive. In the latest specimens—notably the Rolls-Royce Merlin 61, the supercharging is effected in two stages which enables a much higher ceiling to be attained. Although many experiments have been made with exhaust-driven turbo-superchargers in this country and on the Continent, superchargers mechanically driven from the crank-shaft remain standard practice in this country. In America the exhaust turbo-supercharger has undergone great development and is applied with success to Pratt and Whitney and Wright radial air-cooled engines. Aircraft using it include the Boeing Flying Fortress, the Liberator, Thunderbolt and Lightning. The General Electric Co. developed the exhaust turbo-supercharger to its present state, Dr. Sanford Moss having carried out experiments and investigations for many years past.

In essence, the turbo-supercharger is a high-speed turbine driven by the impact of escaping exhaust gases upon its rotor blades. The turbine wheel, or rotor, is mounted on the same shaft as the impeller of a centrifugal blower which delivers air under pressure through the intercooler and carburettor to the engine cylinders. As the turbine is driven by the exhaust gases, which are normally run to waste, it is frequently suggested that the power delivered by the turbine is obtained for nothing. That this is not the case in no way detracts from the striking advantages turbo-supercharging possesses for aircraft engines.

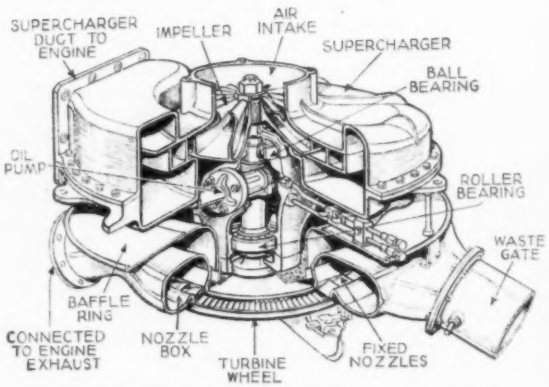
Power Required

To all intents and purposes, the turbo-supercharger provides an infinitely variable degree of supercharge governed by the density of the atmosphere in which the aircraft is flying. To make this clear, it must be appreciated that the power required to drive a blower is dependent upon the *weight* of air it has to displace in a given time. If the density of the air is lessened, the blower will displace less weight of it in a given time, providing the speed of its drive is unaltered, and it will, as a result, take less power to drive it. Conversely, the same power will be able to drive the blower faster under this condition, up to the point where it is again displacing the original weight of air.

The velocity at which the particles of the exhaust gases issue from the engine depends upon the difference between the pressure inside the exhaust manifold and the pressure of the outside atmosphere, and the speed of the turbine rotor is governed by this difference. If outside pressure is reduced, the turbine will run faster and drive the supercharger faster; the nett result is that turbo-supercharging can automatically provide sea-level air pressure in the induction system irrespective of altitude. Practical limitations are, of course, imposed by mechanical considerations affecting the charging system, the engine and the aircraft itself.



Diagrammatic layout of a nacelle installation showing operational cycle.



Sectionalised view of the G.E.C. turbo-supercharger unit.

The diagrammatic layout of a nacelle installation illustrates the operational cycle. Air enters the system through the main air intake and is ducted to the supercharger impeller where initial compression of the air takes place. This compression induces a rise in the air temperature which is reduced by passing the air through the intercooler before it enters the carburettor; this cooling incidentally increases the density of the air charge.

Second Stage

From the carburettor the air/fuel mixture is fed to the intake of the internal (gear-driven) supercharger where a secondary compression is imparted to assure uniform distribution to the cylinders.

The exhaust gases are ejected into the collector ring and delivered via the exhaust duct to the nozzle box of the turbo-supercharger, where they are directed to impinge on the vanes of the turbine motor. Excess exhaust gases are by-passed to atmosphere through a butterfly-throttle waste-gate.

Referring to the sectionalised view of the turbo unit, the exhaust duct is connected to the nozzle box entry at lower left; the nozzles or diffuser vanes can be seen, and these permit an expansion of the exhaust gases, so increasing their velocity, and at the same time direct the gases against the turbine vanes. Power developed by the turbine is transferred through the central vertical shaft to the supercharger impeller. Air admitted through the intake is centrifugally impelled into the ducts in the volute supercharger casing and so into the duct leading via the intercooler to the carburettor. The ball bearing immediately beneath the impeller takes the thrust load of the shaft when the unit is running, and shaft expansion is accommodated by the roller bearing above the turbine wheel. Each of these bearings is housed in the inner casing.

The turbo-supercharger is lubricated by an integral oil pump carried in the inner casing and driven through a worm sleeve and pinion, the former being keyed on to the vertical shaft.

The baffle ring between the nozzle box and the supercharger casing distributes cooling air between the two and also serves to reduce the radiation of heat from nozzle

box to casing. The turbine wheel is itself cooled by a convection cap fed from a forward facing scoop; air admitted is directed by the cap on to the wheel and so prevents the generation of excessive temperatures.

The supercharger control in the cockpit is connected to a regulator unit which governs the aperture of the waste-gate butterfly. The amount of supercharge supplied to the engine is maintained automatically at the correct value for any control setting by the balance of pressures on either side of a piston, the position of the piston governing the position of the waste-gate butterfly, but in the event of an emergency, operation of the cockpit control lever overrides the regular piston and allows any degree of supercharge required up to the operational limitations of the unit.

YORK INTERIORS

NIGHT AND DAY: The interior decoration of the Avro York has been executed by Rumbold Ltd. and is in two shades of grey and black. Curtains are of washable linen in a blue and grey design. All fittings are of polished aluminium. The seats are in black leather with grey piping. Each has an adjustable headrest, and the angle of recline is also adjustable by a touch on a small lever. Beneath each seat is an oxygen economiser, oxygen mask and flotation jacket. The usual safety belts, ash trays and pockets are provided, and the seats are fully rotational to enable passengers to face either fore or aft. The photograph on the top right shows the York's kitchen.

CIVIL AIR PROBLEMS CAN BE SOLVED

MR. HAROLD BUTLER, British Minister in Washington, in a speech at Athens, Georgia, recently expressed confidence that civil aviation problems can be solved amicably.

Addressing the Georgian Press Institute, he said: "There are a number of difficult questions which must be settled between us and the Russians and the Chinese and our other Allies, but I do not believe any of them are insoluble provided we approach them with good will and common sense.

"Take the question of civil aviation. Some people are already wagging their heads and saying that this will be a major cause of dissension before our two Governments have even begun to talk about it. I believe nothing could be more unlikely. We both have consistently advocated the free use of the air. We have been opposed to restrictions on air passage and in favour of opening wider opportunities.

"Pre-war Dutch and French air lines operated from Holland to Australia and from France to Indo-China using British airfields in India, Singapore and elsewhere en route. We in our turn had reciprocal facilities in Dutch and French territory. Quite recently, President Roosevelt laid down two basic principles—the right of innocent passage for all nations in the world and the right to land anywhere for refuelling and non-traffic purposes.

"Last month, Lord Beaverbrook announced with the authority of the Prime Minister that we subscribe to these principles to their fullest extent. Lord Beaverbrook also said: 'The British Government has no desire to exclude other nations' aircraft. We demand no prescriptive right to the use of airfields for ourselves. Rather do we mean to use them for the purpose of steadily developing civil aviation throughout the world.'

"On that basis there should be no great difficulty in reaching a satisfactory agreement about civil aviation. What is true of civil aviation is true of other problems connected with trade and shipping and other things. If there is a will—a good will—to solve them there is surely a way."

In a later speech at a dinner given for him by Georgia University and the Athens Rotary Club, Mr. Butler stressed the amity and co-operation now existing between the U.S. and the British people, and said the Atlantic Charter illustrated our common viewpoint.

The World's Best Aircraft

Impossibility of Assessing Relative Merits by Use of Separate Watertight Quality Factors : Vulnerability Not a Matter of Armour Plate Alone

By R. L. LICKLEY and F. H. M. LLOYD

COMPARISON of aircraft is a difficult and unenviable task, a task which, if one is wise, one should not willingly undertake unless forced to do so for strategic or business reasons. The only infallible yardstick by which the quality of an aircraft may be judged is the result it achieves on operations. The consideration of the many individual qualities of performance and other characteristics introduces so many variables into a single equation that the problem becomes mathematically insoluble, and an answer can only be obtained by the substitution of a "personal opinion" factor for the relative importance of each of the considered qualities. Obviously, the more variables that are introduced the more unreliable the answer becomes.

Mr. Masefield, we submit, has fallen into this trap in his article which appeared in the issue of *Flight* of February 10th as a reprint from an American magazine. Credit is due to him for a most interesting contribution; nevertheless, we believe that the results which he obtains are misleading and do not bear the correct relation to actual results in daily operations.

IN this article two members of the Hawker Design Staff, headed by Mr. Sydney Camm, challenge some of the methods and conclusions of Mr. Peter Masefield's attempt to evaluate the qualities of the aircraft of the fighting Powers, which was published in our issue of February 10th. They point out that the only reliable yardstick with which to measure aircraft qualities is the results it achieves on operations.

Comments from several other readers appear on this week's Correspondence pages (211-212).

The classes into which the aircraft are divided are reasonable in the main, but the entire absence of British types, with the exception of the Mosquito, from the short list of outstanding aircraft leads one strongly to suspect that the author has been comparing British types which have now been in operation for a considerable time with American types which are only now, subsequent to the date of his article, going into service and are therefore relatively untried.

This is obviously unsound, since in effect it amounts to comparing promises with facts and is bound to favour the newest American types, since their corresponding British types may not even be mentioned, owing to the rigour of British secrecy.

The Mustang Puzzle

Of the three aircraft in Mr. Masefield's "Honours List," the first is the North American Mustang II single-seater fighter. While in no way wishing to detract from the very fine qualities of the Mustang, it is impossible to see where Mr. Masefield gets his high position for it, relative to the Typhoon and the Spitfire. The position is further clouded by his reference to a 1943-44 ideal, which is not specified, and which therefore makes his percentage figures technically useless.

Considering the desirable qualities of a fighter, these are:—

(1) High speed; (2) fire power; (3) manœuvrability and rate of climb; (4) duration of flight; (5) vulnerability; (6) serviceability; (7) ease of production.

In any assessment of merit the qualities should be weighed in the above order; obviously, speed to intercept must be the prime consideration and, having contacted the enemy, sufficient effective fire power to destroy him must be available. In this respect, the qualities of the aircraft as a gun platform must be noted and also the amount and type of ammunition available, in addition to Mr. Masefield's assessment of muzzle horse-power.

Thus, 0.303 ammunition is no use if the enemy is heavily armoured against it, and two larger-calibre guns are insufficient if the scatter is so bad that only a low percentage of hits is obtained when using all the available ammunition.

The best armament for a fighter, then, is not necessarily the most guns, nor does it consist of the largest-calibre guns that can be installed in the fighter. Qualities to be considered under the single heading of armament are:—

Armament

(a) Muzzle horse-power.
(b) Smallest number of guns of the smallest possible calibre that will effectively destroy all types of enemy aircraft with the greatest economy of ammunition.
(c) Steadiness of gun platform.
(d) Duration of fire.
(e) Reliability of guns at all altitudes and conditions of flight (e.g., complete freedom from stoppages when flying in very cold temperatures or at high accelerations).
(f) Serviceability of armament.

The question of armament is by no means free from influencing and being influenced by other factors. The best armament in the world is useless if the pilot is unable to see properly by his view being in any way hampered. The carrying of an armament load of 1,000 lb. or more on a single-seater fighter must affect the size and hence the speed of the aircraft, and also the rate of climb and the duration of flight.

Manœuvrability and rate of climb are very necessary for dog-fighting, but without speed and fire power they are in themselves valueless as a means of destroying the enemy. Further, fighting manœuvrability cannot be expressed as a ratio of wing loading, as Mr. Masefield has done, since it depends on many factors; for instance, lightness of controls, ailerons, power loading, and weight/drag density.

Vulnerability, while difficult to assess, is a most important item. Mr. Masefield has considered only armour plate, protected fuel tanks, number of engines and type of cooling, and general layout. He has entirely neglected the point that the factors which contribute most to low vulnerability in a fighter are speed, view, manœuvrability, and pilot's skill and morale. It is presumed that he includes the all-important item of all-round view, and such other items as the position of the radiator of a liquid-cooled engine, in the item "General layout," for which he awards only one point out of ten under this heading.

If, as in the last war, we could only afford to give our pilots a few hours' "solo" before sending them on operations, the casualty rate would rise to such an extent that morale would drop, and we should then have to build-in more defensive armour at the cost of offensive qualities. In the extreme we could cram on so much armour as to make the aircraft invulnerable to fire from the guns of any enemy aircraft. But we should reduce climb performance, manœuvrability, and armament almost to nil. Mr. Masefield's marking of the vulnerability factor tends to favour this extreme, yet the introduction of a gun of sufficient calibre and muzzle velocity would make such a machine the most vulnerable aircraft in service.

We have substituted the serviceability factor for Mr. Masefield's maintenance factor, since maintenance is only in part responsible for the percentage of aircraft serviceable

THE WORLD'S BEST AIRCRAFT

at any given time. Serviceability should include ability to take damage, ease of repair, freedom from defects, and a consideration of the time taken to change damaged units.

Production comes last because if an aircraft is best in all other features, it will be chosen even if difficult to produce. It should be noted that if fewer can be made, its superiority may mean that fewer are required. A case in point with high-speed aircraft is provided by the production of a high quality of surface finish. Many weary hours must be spent on each aircraft, rubbing down the surface and polishing by hand, and although this must mean that the aircraft will take longer to produce, the additional work pays dividends in the form of miles per hour.

The foregoing makes it clear that it is impossible to assess the relative merits of different aircraft by the consideration of separate watertight quality factors, since all are interconnected to such a degree that only the combined result of the whole can be judged by the success which the aircraft achieves on operations.

Unfair Comparison

In the single-seater fighter class Mr. Masefield has compared the Typhoon IB and the Spitfire IX with the Mustang II (Merlin engine). The two British fighters were in service in 1942 and became operational about the same time as the Mustang I with Allison engine. More recent British types are now operational, which unfortunately cannot be named, but it is these that should be compared with the Mustang II. The Typhoon IB and Spitfire IX should be compared with the Mustang I. Even so, we need not be afraid to compare these British two-year-olds with the latest American fighter, either on the basis of success achieved in operations or on Mr. Masefield's basis.

On either count, in the medium-altitude fighter and bomber-destroyer class, the Typhoon IB is still supreme. This is amply borne out by its performance in recent months over the Low Countries and France. In the high-altitude fighter class the Spitfire IX is still the best, largely because it is lighter and smaller than the Mustang, and has greater manœuvrability and ceiling. In the fighter-bomber class the Typhoon is again best as the bomb load is the same as that of the Mustang, and, owing to the greater horse-power available, the deterioration in climb with bombs on is smaller. Also, once the bombs have been dropped, the initial superiority of the Typhoon is still there.

Mr. Masefield is unable to show, for reasons of secrecy, how he awarded his marks, but by "weighting" the various factors in the revised order above, it is found that in the medium-altitude fighter class the Typhoon IB is some 15 per cent. better than the Mustang II. Now, it is of no great importance whether the best aircraft are designed by ourselves, or by one of our Allies, so long as Allied aircraft are superior to those of the Axis, and we should be thankful that in each class the Allies have an aircraft that can beat anything else in its class in the world. There is no point in squabbling between ourselves over the relative merits of the aircraft of the Allied nations, but there is still less point in misleading ourselves into the belief that our own British aircraft are inferior.

The "Heavies"

Coming to the heavy bomber class, it is surprising to note that Mr. Masefield puts the Consolidated Liberator among the three outstanding aircraft of the world, to the exclusion of the Avro Lancaster and the Boeing Fortress B-17G. His conclusion is based on his having given two first places to the Liberator, first as a heavy day bomber and secondly as a long-range patrol bomber (anti-submarine). There may be little to choose between the Liberator and the Fortress, although the invulnerability of the Fortress makes it the more logical choice, but surely the Lancaster with its great bomb load, several times that of the Fortress or Liberator, and its long range, can lay claim to being the most outstanding of all bombers. It is simply because the Lancaster is so outstanding as a night bomber that it is used almost exclusively in that rôle, although we must not forget the Augsburg and Le Creusot daylight raids. If the bomb load of the Lancaster were reduced by 10,000 lb. or more, and this load were replaced by a formidable armament and heavy armour protection, we should have a day bomber similar in character to the Fortress but with a greater range. From the point of view of the Commander-in-Chief of Air Operations the Lancaster carries several more tons of bombs per sortie to the selected target than either the Fortress or Liberator; this is the result by which we must judge.

The Avro York is conspicuous by its complete absence from the list of aircraft considered in the transport class. Since Mr. Masefield has included the most recently released American transports, one wonders why the York has not been considered, since it is at least worthy of an honourable mention.

Mr. Masefield's article tends to give the erroneous impression that in most fields of aircraft development the Americans are ahead of us, but we think it is not unreasonable to submit that in actual fact our latest front-line aircraft and our technical development continue to be at least equal to that of any other nation.

EMBLEMS FOR R.A.F. PERSONNEL MENTIONED IN DESPATCHES

DESPATCHES emblems, wound stripes and chevrons for war service have now been introduced. Those eligible are: (1) Officers and airmen of the British, Dominion, Indian and Colonial Air Forces. (2) Members of Princess Mary's Royal Air Force Nursing Service and its reserve. (3) W.A.A.F. officers and airwomen. (4) V.A.D. members.

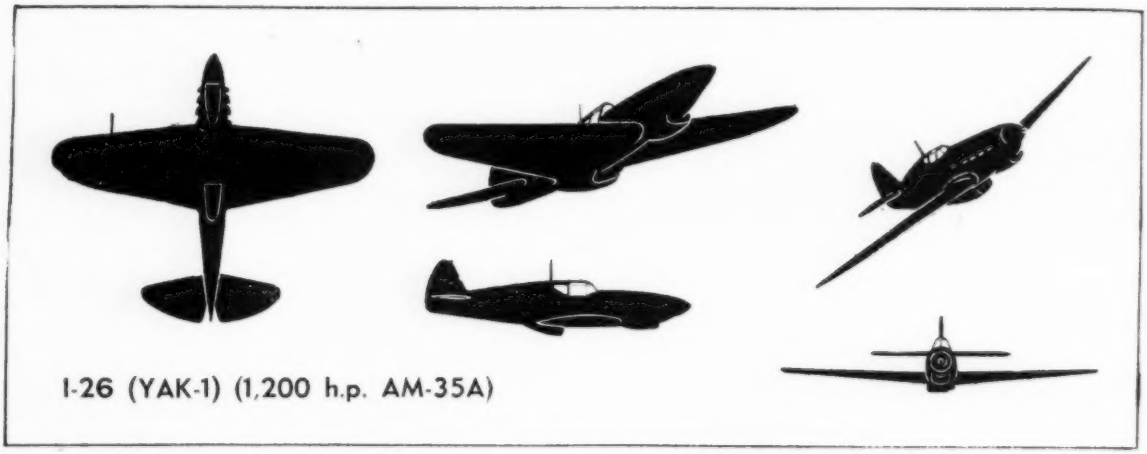
The emblems are in bronze in the form of a single oak leaf and distinct from the pattern authorised for mentions in despatches during the 1914-18 war. The emblem is to be worn in respect of mentions in despatches and commendations gazetted, for service during the war beginning September 3rd, 1939, as a member of one of the classes specified above, or during previous naval or military service, or in civil life. Only one emblem is to be worn, irrespective of the numbers of awards received, and is to be affixed to the uniform, with the stem towards the wearer's right, where a ribbon would be worn.

Stripes denoting wounds sustained in the present war are of gold braid five thirty seconds of an inch wide and one and a half inches long. Those denoting wounds sustained in previous wars are of red rayon of similar dimensions. One gold stripe is to be worn for each occasion on which certain wounds and injuries are sustained during the present war, but only one red stripe will be worn irrespective of the number of wounds sustained. Broadly speaking, wound stripes will be worn in respect of all wounds and injuries directly due to enemy action and sustained while on duty. The stripes will be worn vertically on the left forearm, with the gold stripe or stripes in front of the red stripe. The grant of a wound stripe does not confer any claim to financial recognition.

Service chevrons are printed in red on a blue-grey background for wear with blue-grey uniform, and on a khaki background for wear with tropical uniform. One chevron will be worn for each completed year of service in the present war. Service in the Navy, Army, Home Guard, Police, N.F.S., Merchant Navy, Civil Defence organisations and other services to which the scheme applies may be aggregated with Air Force service for the award of chevrons. Chevrons are to be worn on the right forearm, apex uppermost, and, like wound stripes, may be worn with plain clothes after discharge or transfer to the reserve.

Studies in Recognition

Aircraft in Fi

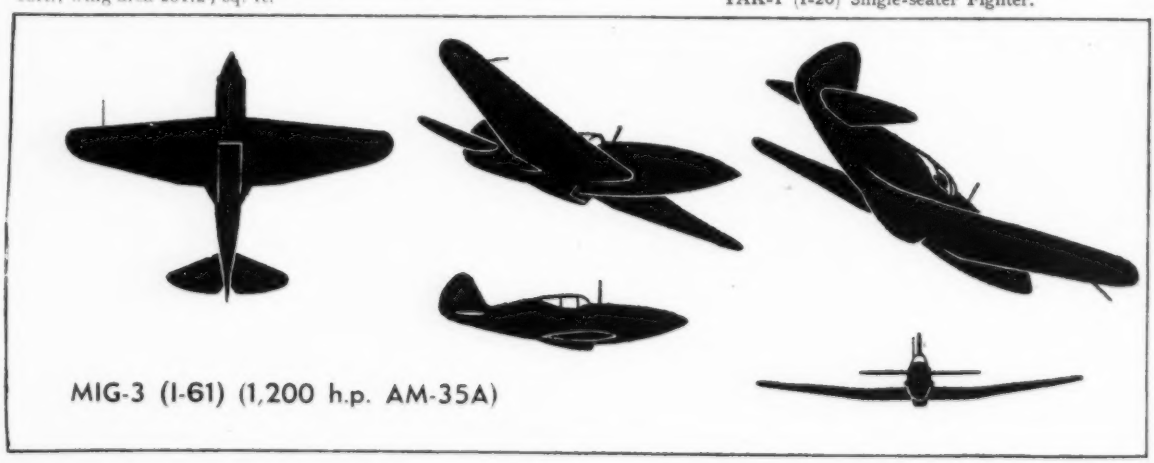


I-26 (YAK-1) (1,200 h.p. AM-35A)

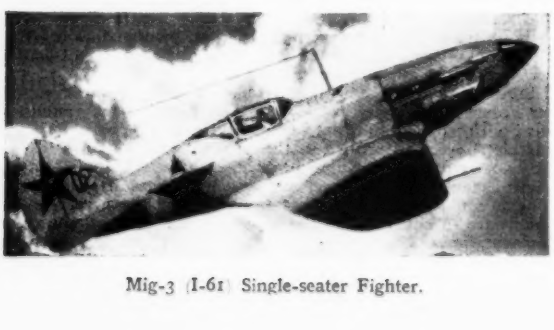
POWERED by a 1,200 h.p. AM-35A 12-cyl. liquid-cooled, in-line V-type engine with two-speed supercharger, the I-26, or YAK-1, has a top speed of 360 m.p.h. As with most modern fighters, armament varies according to the allotted task, one version employing a single cannon mounted between the cylinder blocks and firing through the hollow airscrew hub, and a pair of machine guns above the engine, and another having eight machine guns in the wings.

In appearance the YAK 1 somewhat resembles the Tomahawk, especially about the nose and tail unit, but its wing plan is different and tapers on both edges to round tips, and its tailplane is larger and of higher aspect-ratio. An airscoop under the nose and a radiator amidships are two useful recognition points. Dimensions:—Span 38ft., length 32ft., height 10ft., wing area 281.25 sq. ft.

YAK-1 (I-26) Single-seater Fighter.



MIG-3 (I-61) (1,200 h.p. AM-35A)

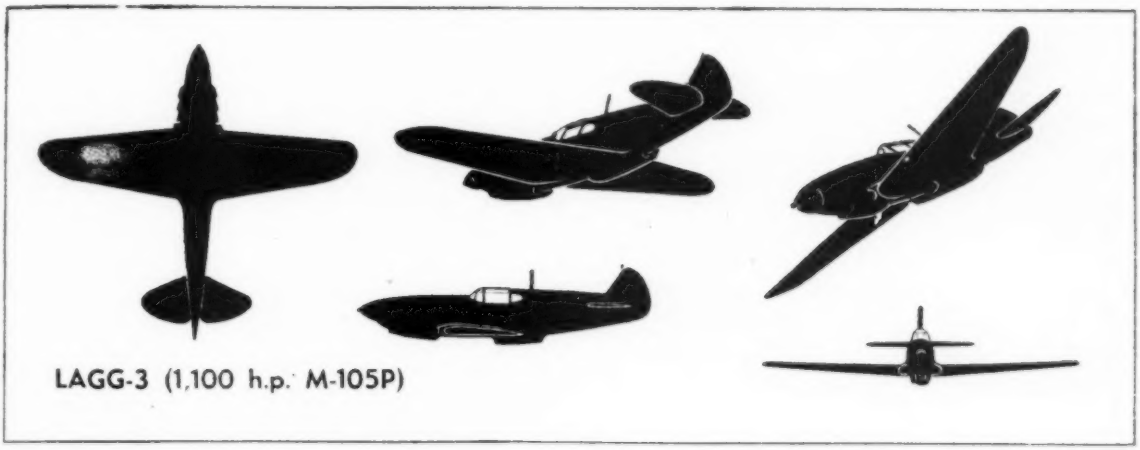


Mig-3 (I-61) Single-seater Fighter.

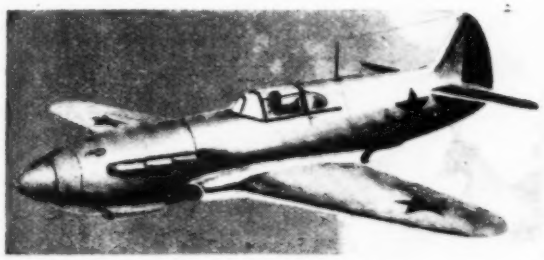
THE Mig-3 has often been called the Russian Spitfire, and at the time of its introduction was easily the fastest of the Russian single-seater fighters.

The power unit is the same as that of the YAK-1, namely an AM-35A, and top speed is 360 m.p.h. Armament varies according to the job in hand; earlier versions all had eight wing guns, but later equipment may be either one 0.5in. machine gun above the engine and one 0.30in. gun on each side of it, or two cannon and four machine guns for ground strafing. Tapered wings with wide flat centre-section and large fillets, wide "wing-nut" tailplane, deep oval fuselage with long pointed nose, and radiator below the amidships cockpit form the chief recognition points. Dimensions:—Span 37ft. 6in., length 31ft. 2in., height 10ft. 6in., wing area 240 sq. ft.

Fin[illegible] Attitudes



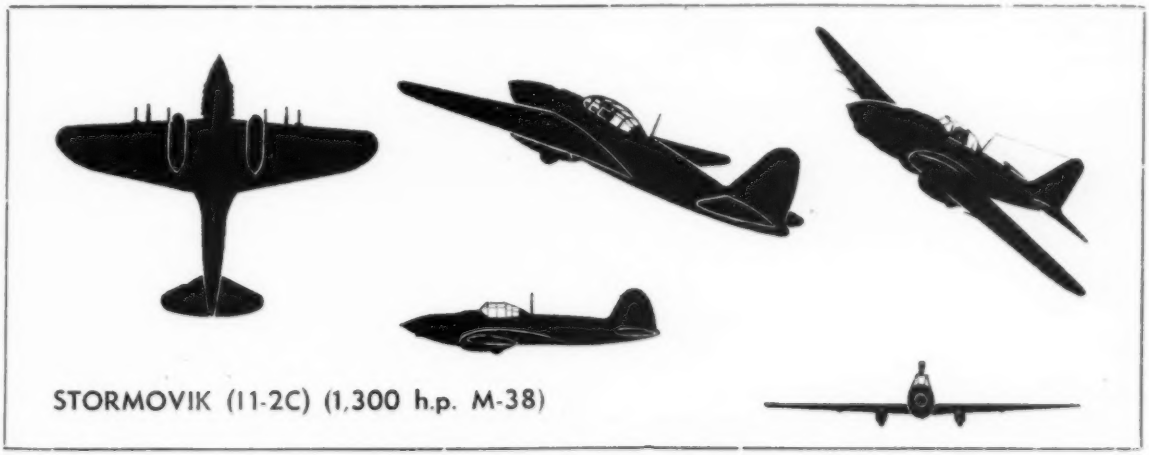
LAGG-3 (1,100 h.p. M-105P)



Lagg-3 Single-seater Fighter.

OF wooden construction, the Lagg-3 has proved to be a very successful fighter and has been produced on a large scale. It is powered by a 1,100 h.p. 12-cyl. liquid-cooled V-type M-105P engine and has a top speed of about 350 m.p.h. at 16,400ft., and a service ceiling of 29,500ft. Basic armament comprises a 20 mm. motor-cannon firing through the airscrew hub and a pair of 12.7 mm. synchronised machine guns mounted in the nose.

Recognition features include tapered wings with round tips, "wing-nut" tailplane and small fin and rudder. The fuselage has a flat top line and tapers very little, and there are air scoops in the wing roots as well as an oil-cooler under the nose and radiator beneath the cockpit. Dimensions:—Span 31ft. 9in., length 29ft. 6in., height 8ft. 4in., wing area 188 sq. ft.



STORMOVIK (11-2C) (1,300 h.p. M-38)

DESIGNED specifically as a low-level attack bomber, the Stormovik (11-2C) is a low-wing single-seater powered by a 1,300 h.p. 12-cyl. liquid-cooled M-38 engine which is well protected by armour, as is the cockpit. Its top speed is about 280 m.p.h. and it has gained considerable success as a rocket bomber. Four 250 lb. bombs are launched from rails under the outer panels of the wings and projected at the target. It is also equipped with two 32 mm. cannon and four m.g.'s.

Recognition points include moderately tapered wings with curved tips and very little dihedral angle, tailplane with sharply backswept leading edge and curved trailing edge, low aspect-ratio, curved fin and rudder, long, oval-sectioned fuselage with raised cockpit cover, and large fairings for the backwardly retracting undercarriage. Dimensions:—Span 49ft., length 38ft. 6in., height 12ft. 9in., wing area 439 sq. ft.

Stormovik (11-2C) Attack Bomber.

Behind the Lines

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

Something in the Air

ENEMY sources report that the Japanese Air Arm has put a new fighter into service. Details of the fighter are not given, but it is stated that it made its début in combats over Rabaul.

Recruiting

AN appeal published in the German Press asks boys born in 1928, 1929 or 1930 to join the pre-military training groups as pilots and wireless operators organised by the Flying Section of the Hitler Youth. "The way to our Air Force should and must be voluntary," the appeal adds.

A Civvy

FULLER details are now available of the four-engined courier and civil aircraft developed by the German *Siebel Flugzeugwerke*, of Halle.

Designated Si 204 the aircraft is powered with Argus As 410 8-cylinder air-cooled in-line engines of 450 h.p. and has a maximum speed of 220 m.p.h. The span is 70ft., length about 40ft., and wing area 400 sq. ft.

There'll Be No Night

A REPORT by Vichy radio says that German A.A. defence experts have put into service a new type of searchlight equipped with an infra-red rays device. The infra-red rays will be used to penetrate natural and artificial clouds and pick out aircraft trying to take cover behind clouds, but instead of attempting as hitherto, to locate single aircraft, the new searchlights will be employed as a "barrage" and over long distances.

The same report adds that a new type of Focke-Wulf night-fighter has been equipped with this type of searchlight, and several plants are turning out a number of aircraft fitted with the same device.

No Gaps?

ATTEMPTS to attack German aircraft factories have had very little effect, asserted a prominent German aircraft designer interviewed by Karl Zeppelin, the German air correspondent. Reason: any gaps have always been made up by reserve shifts in parallel factories.

The production of aircraft, he said, has increased in a most satisfactory manner and was never so great as it is to-day. This has been achieved because of readily available raw materials and manpower, as well as by rationalisation methods and the introduction of new specialised machinery. "Many new aircraft and engine factories have been built since 1939.

Referring to German official reports, which have repeatedly emphasised the numerical inferiority of the *Luftwaffe* on certain fronts, Zeppelin said that there are various answers to this riddle. Here they are: (1) Expansion of the defence forces of the Reich demanded a larger number of day- and night-fighters. This demand was given priority over other fronts. (2) It was possible that considerable forces, including reserves, have been set aside for the possibility of invasion and are not being drawn upon for the time being. (3) It might be imagined that a special contingent of bombers is set aside for the retaliation which has been repeatedly announced. (4) The shortage of aircraft which at times was noticeable last year, for instance in the Mediterranean, may have been brought about by a switch-over to completely new types of aircraft. In such instances there is usually a certain slowing-down in supplies.

Piggery

SINGLE-ENGINED single-seater fighters adopted for night fighting, according to Col. Hajo Hermann's suggestions last autumn, are known in *Luftwaffe* circles as "Hermann Fighters" or "Wild Sows." It was in the summer of 1943, following a number of mass attacks that Col. Hermann's suggestion to meet bomber formations over the target area by large formations of single-seater fighters was adopted; their employment in large "packs" is said to have taken place for the first time during the raid on Hamburg.

German reports mention that these "Hermann Fighters" are modified Me 109 and Fw 190 types and point out that pilots must undergo special training because of difficulties in take-off and landings. In addition, weather conditions, especially in winter, are said to be another handicap, as the single-seater fighters must do without many of the advantages enjoyed by the twin-engined type capable of blind flying.

Boost

GERMAN propaganda makes much of the "Albert Leo Schlageter" fighter squadron which is credited with 2,000 air victories.

It is said that ever since 1940 the squadron has been in action exclusively against Britain and is now under the command of Lt.-Col. Priller.

Jap Estimate

A VICE-ADMIRAL of the Japanese Navy, who is referred to as "the father of the Japanese Fleet Air Arm" has stated that the U.S. had from 100,000 to 200,000 aircraft available to meet their needs on various fronts. Of these 60,000 were reserved for the Pacific theatre of operations.

Although Japanese pilots are superior —said the admiral—Japan would need at least 50,000 aircraft to face the U.S. strength successfully.

Jap Bottleneck

IN a speech made in the Japanese diet the Japanese Minister Tishi tried to explain the difficulties facing Japanese aircraft production. He stated: "There are many bottlenecks in the Japanese aircraft production programme. Some people say these are due to bungling on the part of the Government in the mobilisation of essential war materials. I must emphatically deny these charges. The difficulties are much more due to war circumstances and are caused by other unforeseen factors."

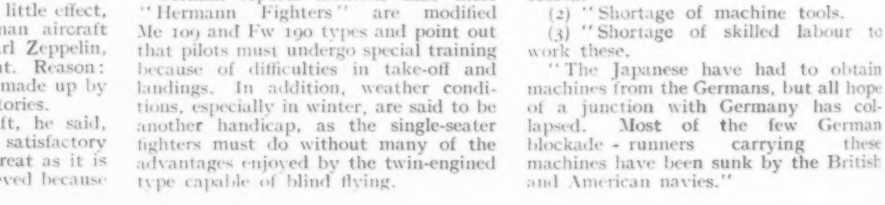
Sydney radio, quoted by Reuter, supplies the following details of Japanese difficulties:—

(1) "The shipping shortage caused by the sinking of more than 3½ million tons of Japanese merchant shipping since Pearl Harbour. This has seriously curtailed the importation into Japan of various war materials vital for aircraft production. It has forced the Japanese to fall back on expensive and inferior substitutes available in Japan and Korea.

(2) "Shortage of machine tools.

(3) "Shortage of skilled labour to work these.

"The Japanese have had to obtain machines from the Germans, but all hope of a junction with Germany has collapsed. Most of the few German blockade-runners carrying these machines have been sunk by the British and American navies."



SATELLITES: Buecker Jungmann and a Me 109 with Hungarian markings on the Russian front. Units of the Hungarian air force are still operating against Russia.

AIR FILTRATION

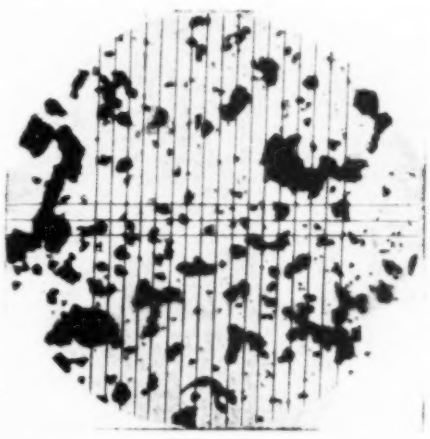
In the Western Desert aircraft engines sucked up many ounces of sand during the warming-up period.

How Two Types of Air Filters Have Prolonged Engine Life : Dust-retaining Capacities from 20 to 45 per Cent.

By C. G. VOKES, A.M.I.Mech.E., A.M.I.Ae.E.

ON the morning of December 17th, 1903, Orville Wright made the first flight in the history of the world in a machine heavier than air at Kittyhawk, North Carolina; on the night of December 17th, 1943, "a large force of our bombers" made one of their raids on Berlin, dropping 1,500 tons of bombs on the German capital in less than thirty minutes. Orville Wright's machine travelled about twenty yards; our bombers flew, in close formation, a round journey of 1,200 miles at great altitudes, and often through cloud banks three miles high. There you have in two sentences the guide marks and full graphic measure of the staggering progress made in aviation in only forty years.

The bare facts themselves are both testimony and tribute to the devotion, ingenuity and skill which have been given to the building up of this industry, whose future is like a happy shadow cast over present magnificent accomplishments. The greatest strides have naturally been made in recent years, under the compelling urgency of war needs, which have from time to time stressed weaknesses, which in their zeal designers and others concerned were prone to overlook.



Dust particles. Each division is 10 microns.

One of the most important of these was the problem of filtration. Those who were responsible for the commercial and administrative sides of civil aviation in the years before the war almost unanimously denied that there was such a thing as engine wear, and were, consequently, not interested. Designers and pilots, concerned almost solely with obtaining maximum power, height and ever greater speeds, were concentrating on streamlining and they were naturally intolerant of anything which threatened interference with their policy. Thus, although filters for aircraft have been made for some thirteen years, no really satisfactory footing was ever established in civil aviation.

It may seem something of a paradox, therefore, to say that in relation to military aviation the position has been almost the exact opposite. Those in charge of Air Ministry policy, and subsequently the Ministry of Aircraft Production, quickly realised the importance of filtration. They knew that in war one of their chief anxieties would be to keep their aircraft constantly in operational condition. Their machines would have to operate in varying climates and temperatures and in every variety of dust con-

AIR FILTRATION FOR AIRCRAFT

ditions. Makeshift airfields would have to be used frequently, and even good airfields would be subjected to disruption by enemy attacks. Moreover, it would never be possible always to have fully staffed maintenance units on hand at all the right places at the right times, with adequate supplies of spares and equipment. Aircraft would most certainly be lost through unavoidable causes; it was of the highest importance that as few as possible should be lost through avoidable causes.

If really efficient filters could be provided, engine life would be considerably lengthened, the morale of the crews would be correspondingly benefited, and the output of the aircraft factories would increase in value, because fewer of the new machines would be needed to replace losses.

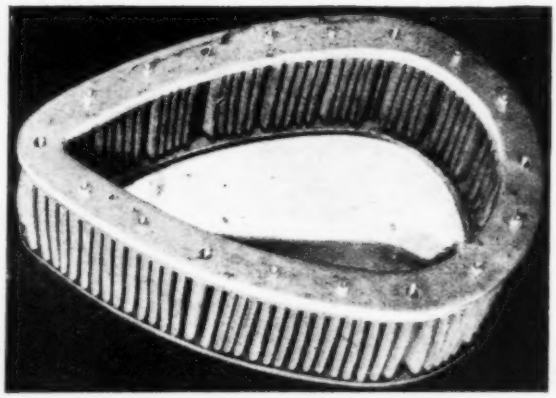
But their requirements amounted to an enormous problem which called for rapid solution. They demanded a high standard of filtration efficiency, which in itself necessitated an enormous filtering area; they insisted that the filters should be small, light, dependable, easily serviced, of patterns to fit the various types of machines, and, of course, they were not to have any appreciable adverse effects upon speeds and altitudes. It was a tall and urgent order.

Engines clogged-up in Few Minutes

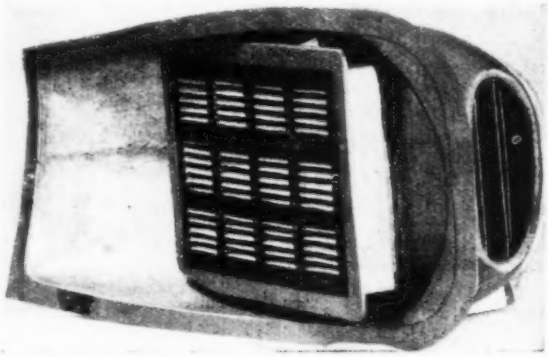
Furthermore, the dust conditions actually encountered were unfortunately far worse than had been envisaged. In the battle over Europe in the earlier days of the war in Holland, Belgium and France, engines were wearing out after about fifty flying hours, and even on some of our airfields in this country engine wear and high oil consumption were observed, on occasions, after as little as ten hours. In the Western Desert, conditions were appalling. Sandstorms, often rising to a height of 18,000 feet, buried everything, and aircraft on the ground were lost to sight at only a few feet distance. Engines were clogged up in a few minutes; even in "normal desert conditions," aircraft taking off fed many ounces of sand into their engines by airscrew action during the warming-up period, and this was especially so when they were taking off in formation, each aircraft taking the full force of the sand swept up by the machines in front.

All these problems have been overcome by two types of filter which we have now been producing in great numbers —the Vokes Aerovee and the Vokes Three-ply.

The Aerovee is a dry type filter, constructed of non-inflammable material and very light in weight. It is made in five layers; two of wire gauze between which there are two layers of fabric, with a centre layer of cottonwool.



The Vokes Three-ply is a viscous type of filter fitted on air-cooled engines. This picture shows the inner assembly for a Bristol Blenheim.

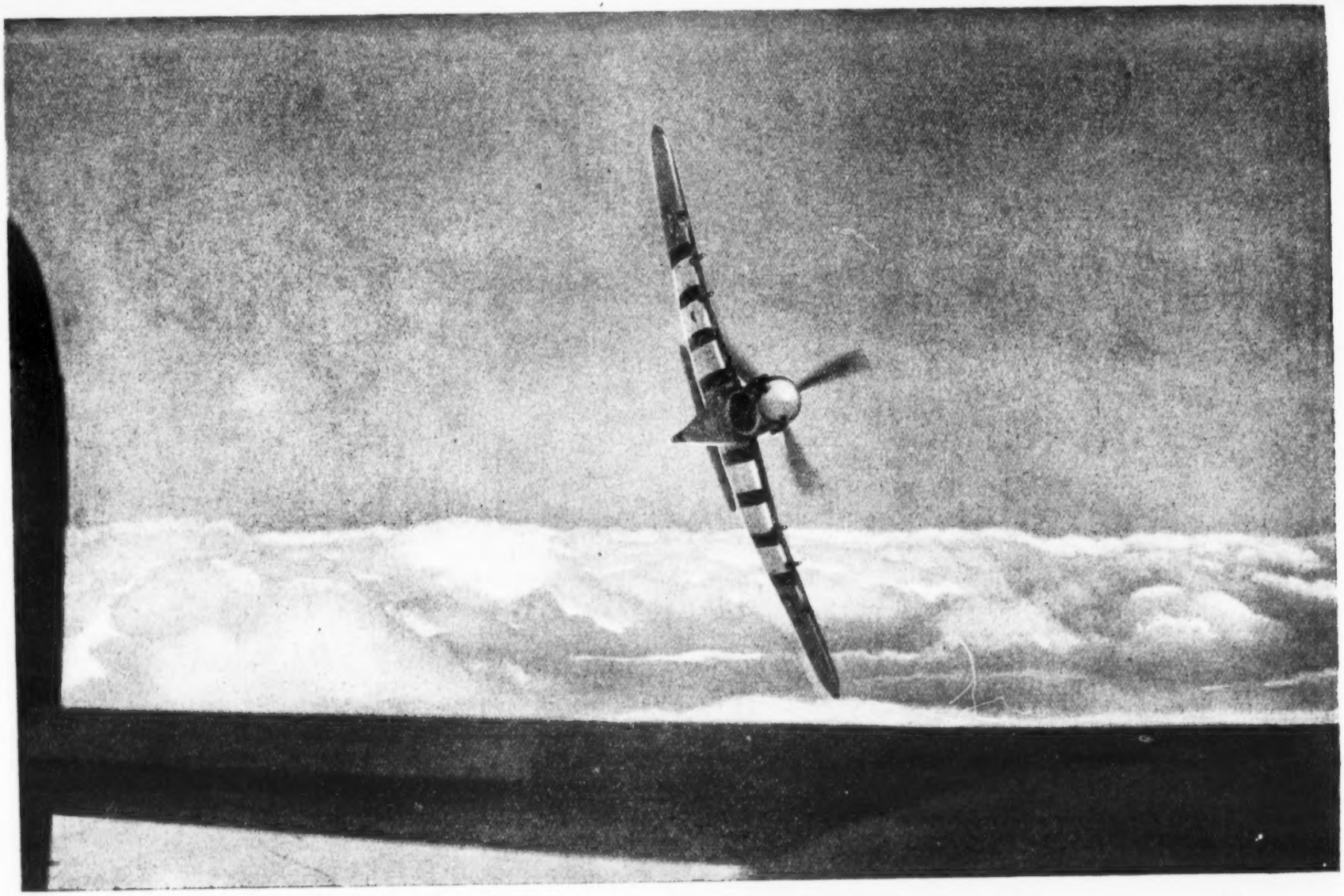


The Vokes Aerovee is a dry type of filter, fitted on liquid-cooled engines. This one is from a Whitley.

These layers are stitched together and are then corrugated into deep folds, so that in relation to the air inlet, an enormous filtering surface is created. The ratio is, in fact, about 200 to 1. The filter element is housed in a light fibre frame and tilted at such an angle that dust particles in the incoming air tend to fall gravitationally from the filtering surface. This type of filter is largely self-cleaning, engine vibration shaking it free from accumulated dust; when servicing does eventually become essential, it is only necessary to take out the element and tap it sharply a few times against a dry flat surface.

When the Aerovee was first introduced, although it passed the severest filtration tests, doubts were expressed that because of its construction it might catch fire from exhaust flames. It was, however, proved conclusively by special tests, in which engines were deliberately back-fired for approximately one hour, that far from this being the case, it was an excellent flame-trap. Especially built to fit into the design of the aircraft, the Aerovee is installed with in-line engines. It is now part

"Tropicalised" aircraft of an Australian Spitfire squadron in the Western Desert, fitted with Vokes filters.

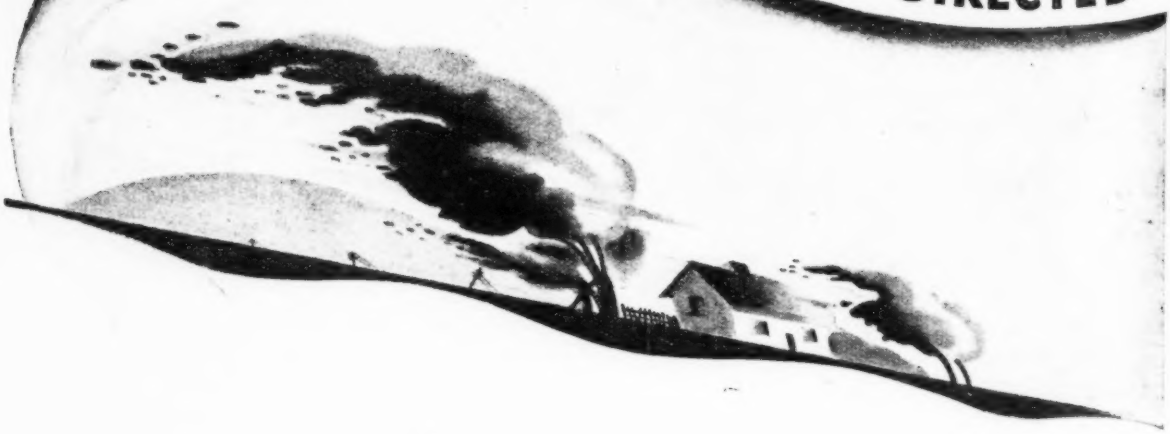


"Flight" photograph

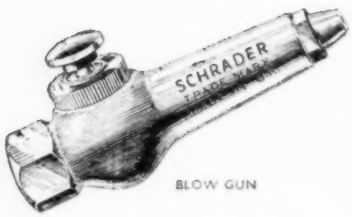
'Achtung, Typhoon!" The latest and most formidable fighter in the world bears down on an "enemy" plane.

Advt.

IF A CYCLONE'S POWER COULD BE DIRECTED



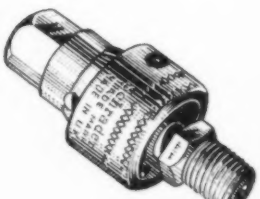
. . . be sure Schrader would do it!

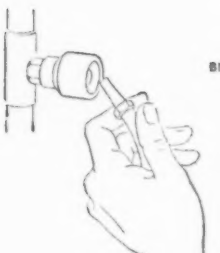


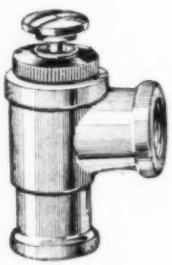
BLOW GUN

We have made a life-long study of the problems of compressed air control. Schrader equipment on your airlines saves both air and your operative's time.

BLOW VALVES . BLOW GUNS . QUICK-ACTING COUPLERS
HOSE COUPLINGS (Male, Female and Repair) . REDUCING ADAPTERS . HOSE FERRULES . PRESS EJECTION SETS . ETC.


QUICK-ACTING COUPLER & ADAPTER

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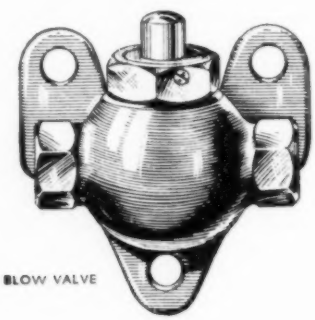

BLOW VALVE

Schrader
Trade Mark

AIRLINE EQUIPMENT

A. SCHRADER'S SON (Division of Scovill Manufacturing Co.) 329 TYBURN ROAD, ERDINGTON, BIRMINGHAM, 24.

AIR FILTRATION FOR AIRCRAFT

of the standard equipment of the Hurricane, Spitfire and Defiant fighters and of the Wellington I.c, the Manchester and Halifax I bombers.

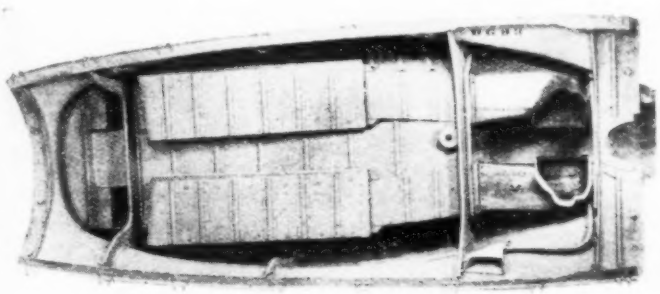
In overall size models vary between 100 and 500 square inches, with weight from 1.5 lb. up to 6-8 lb.; capacity in c.f.m. ranges between 560 and 3,185, with take-off h.p. capacity between 375 h.p. and 2,120 h.p.

For Air-cooled Engines

The Vokes Three-ply is a viscous type filter. It comprises two layers of wire-mesh gauze between which is a layer of fabric, acting as an oil-retaining agent, and thus maintaining the highest efficiency for the longest period between servicing. As in the case of the Aerovee filter, the material is folded into deep corrugations, again producing an enormous filtering surface to disperse dust accumulations over the maximum area. It is housed in a metal frame. Cleaning is done by thoroughly washing the filter element in petrol or paraffin, and allowing it to dry. It is immersed in engine oil and, after draining for about thirty minutes, is again ready for service.

The Three-ply is fitted to air-cooled engines, and is standardised on the Beaufighter, the Beaufort, the Blenheim and Bisley, the Stirling, Albermarle and Halifax II. It is also used by the American Boston, Maryland and Lockheed Hudson III, IV and VI.

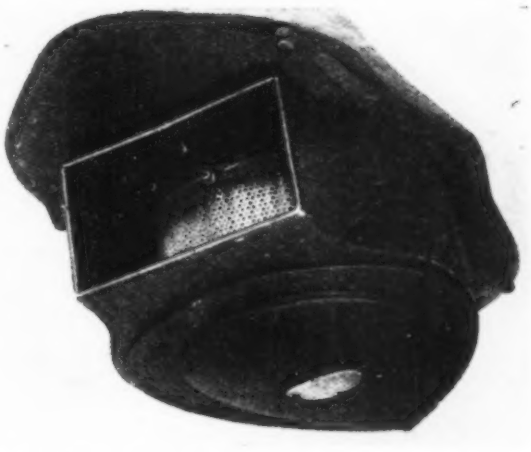
Really remarkable results have been achieved. Both these types of filter are guaranteed to give fifty hours of actual service. In fact, they have stood up to over two hundred hours' service. That is to say, the same types of engine that were worn out in fifty hours in the European theatre, and in thirty-five hours in North Africa, were still worth reconditioning after two hundred hours' flying. In the first case, engine life has been quadrupled; in the second, it was multiplied six-fold.



Filter and casing as fitted on a Boulton Paul Defiant.

In spite of this it must be admitted that neither the Aerovee nor the Three-ply reaches our normal efficiency rating. For general engineering, industrial and air-conditioning purposes our standard rating is 99.9 per cent. But the enormous horse-power developed by engines, and the very limitations imposed in the matter of the size and weight of the filters, has made it impossible to reach this level. The rating is therefore slightly below —95 per cent. This has been established not by laboratory tests alone but by actual flying experience. Certified performance figures show that, with a pressure drop of less than 2in. water gauge, dust-retaining capacities are as follows:—

Particles of from 500-50 microns, 45 per cent.; 50-10 microns, 35 per cent.; below 10 microns, 20 per cent. What this means can be better visualised when it is recalled that a dust particle of 10 microns is only one-tenth the width of a human hair.



The air filter of a Halifax, showing the outer wire gauze element. Between it and the inner gauze are two layers of fabric with a centre layer of cottonwool between them.

By comparison, filters in use on enemy aircraft are of a very indifferent character. Several have been submitted to tests and have been found to be of less than half this efficiency rating. The effects of this upon crews, upon engine wear, and the need for replacement, and the consequent drain upon the enemy's production resources are not difficult to imagine.

Air cleaners are so made now that, in order to avoid interference with high-altitude flying, they can be moved out of position or otherwise blanked off when necessary, so that the intake gets the full ram effect, but, of course, of unfiltered air.

In addition, there are oil filters for oil-circulating systems, for gun-turret mechanisms and for hydraulic undercarriages. So successful have been the air cleaners that air filters are now also being supplied for blind-flying instruments, radio transmitters and receivers, cabin blowers, generators, magnetos, oxygen apparatus and a host of other small items. The experience gained will be available for application to civil aviation after the war.

TRAINING OPERATIONAL PILOTS AS INSTRUCTORS

IN the West of England a R.A.F. station which has no operational aircraft, probably has more decorated personnel than any other unit in the country. It is a flying instructors' school of Flying Training Command, and it is not unusual to find 30 or 40 D.F.C.s in the officers' mess there. Most of them are taking a course.

The unit is unique in another sense. It represents a cross section of the operational commands at home and overseas. Its "pupils" have a tremendous diversity of experience, ranging from service in the Arctic to the Burma jungles. Here are officers from almost every battle front, their ranks ranging from warrant officer to squadron leader.

The purpose of the unit is to train operational pilots as instructors. The rest period which the operational pilot gets when he has finished his tour usually involves some months on instructional work, and as men of action are often men of few words, they have to be taught the art of instructing, so that they can pass on their knowledge to others.

Pilots who take a course are often considerably surprised to find that their flying is far from being as smooth and polished as it should be. Operations tend to make a pilot's flying a bit "rough," so at this school, flying in Oxfords or Masters, the pilots polish off the edges and assimilate the art of instructing.

The chief flying instructor is a famous fighter pilot, Sqn. Ldr. M. M. Stephens, D.S.O., D.F.C., and two bars, who has seen a great deal of action in the Mediterranean. He has done about 550 sorties, mostly in fighters or fighter-bombers, and has had many combats.

Percival Proctor IV

Three-seater Wireless Trainer or Four-seater Communications Aircraft

THE Proctor IV is a three-seater low-wing monoplane with a 210 h.p. De Havilland Gipsy-Queen engine, designed to an Air Ministry specification as a wireless trainer for the Royal Air Force and the Air Branch of the Royal Navy. It is a successor to the Percival Gull and Vega Gull.

The new trainer, although somewhat similar in appearance to the earlier Proctors, is actually a completely redesigned aircraft, both from the aerodynamic and structural point of view. The most noticeable thing about the Proctor IV, compared with the earlier Proctors, is a longer and deeper fuselage, with the tailplane set higher in relation to the wing

From the operational point of view this new Percival trainer is much improved by the wider and deeper cabin and by the lower engine cowling line. The pilot, being seated well forward, has a very good view over the nose and leading edge of the wing.

The Proctor IV has been designed to carry the full equipment necessary for training the wireless operators of our big bombers. The possibility of other uses for the Proctor IV has been kept in mind from the outset of the design. The need for an economical four-seater communications aircraft was foreseen, and when, after the first Proctor IV had been delivered, the designers were asked about a communications version they were able to provide it. The removal of over 200 lb of wireless training equipment allows for the carrying of an extra passenger and some luggage in addition. The unit construction of the seat bearer and control unit assembly allow for conversion to a side-by-side dual control trainer in a few hours, without any structural alterations.

Wood is used for the main structure, with metal fittings joining the various components together, and plastics are used for a large number of non-stressed and lightly-stressed parts. Synthetic resin glue is used throughout for bonding the wooden parts together, and the interior is coated with seaplane varnish, making the whole structure practically waterproof. With the large inspection panels fitted at different parts of the structure, maintenance and repair is easy to carry out.

The wing is in three sections. The centre portion, of parallel chord and thickness, carries the undercarriage units and is bolted to the bottom of the fuselage by four bolts. The fuselage is recessed so that its undersurface and that of the centre section coincide. The outer wings taper in chord and thickness and are attached to the centre section by stainless steel fittings.

The outer wings and centre section have two box spars connected at intervals by bulkheads and spruce diagonal bracing members. The contour is formed by wooden ribs, and the leading edge is reinforced by plywood extending back to just behind the front spar.

Wooden split trailing-edge flaps are fitted from the aileron to the side of the fuselage, and are operated by a hand lever in the cockpit.

The fuselage is built up with four spruce longerons, plywood sides, and a pre-formed ply bottom skin. The top decking is plywood over laminated spruce frames, and the complete structure is fabric covered.

Hinged doors are fitted to each side, allowing easy access to the cabin from the wing. These doors can be readily jettisoned, in cases of emergency, by pulling down levers mounted in the roof.

A robust long-travel undercarriage unit is positioned under each end of the centre section, giving a wide track (9ft. 9in.). Each unit consists of a cantilever compression leg, incorporating steel springs and a hydraulic recoil damper.

A De Havilland Gipsy Queen II engine of 210 h.p., driving a De Havilland constant-speed airscrew, is mounted in the nose of the fuselage in rubber anti-vibration blocks on tubular steel bearers. The ignition system is fully screened. A vacuum pump is fitted for the operation of the blind-flying instruments. A large generator is driven by the engine through the medium of a flexible drive.

A 20-gallon fuel tank is mounted in each outer wing, at the root end between the spars. The oil tank, of 3.8 gallons capacity, is mounted in the leading edge of the centre section on the port side. An oil cooler is fitted at the inboard end of the tank and faired into the centre section, with an outlet flap adjustable on the ground. The engine can be started from the cockpit.

A special feature is the control unit and seat bearer assembly which forms a readily detachable unit bolted to the centre section.

The elevator trim tab control wheel, with its indicator, is mounted in the roof above the pilot. The rudder trim tab control, with its indicator, is on the port side of the instrument panel. The split flaps are controlled by a spring-assisted lever at the pilot's left hand, giving three positions.

The cabin carries the largest type of wireless sets, as installed in operational aircraft Intercommunication telephone equipment for each member of the crew allows a wireless instructor in the rear seat to talk to the pupil or the pilot.

A fixed aerial and a trailing aerial cover the whole range of wavelengths needed for wireless training. The direction-finding loop aerial on top of the cabin can be used for instruction in flying on a wireless beam or checking position by taking bearings on two or more wireless stations whose positions are known. For training in visual signalling to ships or to troops on the ground, there is an Aldis lamp stowed beside the rear seat.

The Proctor IV is completely equipped for night flying with the standard R.A.F. blind-flying instrument panel, cockpit lighting, landing lamps in each wing, navigation lights and downward identification lamps.

When used as a four-seater communications aircraft the single rear seat is replaced by two rear seats.

PROCTOR IV WIRELESS TRAINER
210 b.h.p. De Havilland Gipsy Queen II Engine

Span 39ft. 6in.		Length 28ft. 2in.	
Aspect ratio 7.72		Wing loading 17.3 lb./sq. ft.	
Wing area 202 sq. ft.		Power loading 16.8 lb./b.h.p.	
Tare weight with full equipment			2,370 lb.
Disposable load			1,130 lb.
Maximum permissible all-up weight			3,500 lb.
Top speed (sea level)			160 m.p.h.
Maximum permissible cruising speed (sea level)			148 m.p.h.
Econon.ical cruising speed (sea level)			140 m.p.h.
Landing speed (flaps down)			55 m.p.h.
Rate of climb at sea level			700 feet per minute
Time to reach 5,000 feet			9 minutes
Ceiling			14,000 feet
Run to take-off (no wind)			320 yards
Run to clear 50-foot screen (no wind)			650 yards

All performance figures based on official trials at the maximum permissible all-up weight of 3,500 lb.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers not necessarily for publication, must in all cases accompany letters.

THE WORLD'S BEST AIRCRAFT

Masefield's "Artificial Sub-divisions"

SOME of Mr. Masefield's conclusions on the subject of Allied aircraft show considerable muddled thinking, largely owing to the number of artificial sub-divisions into which he has divided his aircraft

Consider first the function of a good heavy bomber. This function is to carry the greatest bomb load the longest distance in the least time.

Allied bombers answer to that classification in this order: Lancaster, Halifax, Stirling, Liberator, Flying Fortress.

The Liberator and Flying Fortress operate by day because their crews (U.S.) are not trained in night flying; consequently, they have to bump up their armament at the expense of their bomb load. This fact, and the consideration that they cannot carry the largest bombs detracts from their bombing efficiency.

As for fighters, on January 6th, 1944, Vickers-Armstrong, Ltd., advertised in *Flight* that the Spitfire was still the fastest and finest fighter in the world. This is the literal truth, but as to which mark, well, that is another matter—ask M.A.P., or Uncle Tom Cobley, or Adolf Hitler.

COLIN R. BARTY.

Some Very Odd Omissions

DOUBTLESS you will see many letters on this extremely contentious article. It is not at all clear exactly how he arrives at his results. One would have thought that, considering a bomber, for instance, you would take the major requirements and give each requirement so many marks, so that the ideal would add up to 100. If he had done that and given us the marks for each requirement, we should have been better able to judge whether his final results are accurate or not.

I would, however, like to refer to Table 1 on page 147. Long range, heavy day-bomber, it would appear, requires no bomb load, but does require defence, while a night-bomber requires bomb load and no defence—very odd indeed! (c) Agreed. (d) Requires no speed—also strange!

Then we come to the second table: A dog-fighter requires no guns, nor does a high-altitude fighter. A single-seat fighter-bomber requires speed and bomb load, but no gunfire. An escort fighter requires no gunfire. A bomber-destroyer requires fire power and speed, but no manœuvrability. A night-fighter requires speed, range and fire power, but no manœuvrability.

All very odd, as far as I can see. E. N. BRAY.

Mischievous Misrepresentations

I WAS interested to read the article by Peter Masefield which appeared in last week's issue of *Flight*. I must confess that at the time I felt an unreasoning antagonism towards his adductions which calmer reflection has proven justifiable. Mr. Masefield, whose present position gives an unwarrantable stamp of authority to any pronouncement he may care to make, has based his selection of "best" aircraft upon a specious formula, the acceptability of which can only be allowed providing certain very important conditions are met.

Utterly apart from the efficiency formula are his selective categories. These appear to have been chosen deliberately to admit certain aircraft types solely upon secondary features they possess, whilst at the same time eliminating superior aircraft which may not be specifically fitted for the duties of the classification in which Mr. Masefield has chosen to place them.

One of the principal harmful aspects of the article is that the author erects a defence by asserting that parts of his selection are based upon information which is secret, as yet, and that consequently the vast mass of his readers have no data against which to assess the accuracy of his adductions. This is very true, and the result is that only people who have access to the information are in a position to refute the selection he has ventured to make.

I have absolutely no hesitation in asserting that the picture drawn by Mr. Masefield is grossly distorted and can truthfully be assessed as coming very close to a mischievous misrepresentation of the factual state of affairs. There is a very clear schism between a personal opinion and a statement of fact, and in my view the article in question is, by the very nature of the selective formula and list of categories, debarred from classification as an opinion.

The assessment of relative values for various aircraft makes and types is, unfortunately, invidious—particularly when nationality is involved—and any list prepared can easily be disrupted in favour of a different list by manipulating the classification. Unhappily the value of a formula such as that used by Mr. Masefield is undermined by the many alternative choices of assessment qualities which can, if so manipulated, make any selection of aircraft superficially tenable, without any regard whatsoever for fiducial qualities.

If it *is* felt necessary to classify the world's aircraft into comparative values of worth, then the only basis upon which it can truthfully be done is (i) reduce all performance to I.C.A.N. conditions, and (ii) classify all aircraft types into *actual* operational categories. "MAGNA EST VERITAS."

Weakness of Indirect Comparison

I READ with great interest the article by P. G. Masefield as printed in *Flight* last week. It is probably the first time that anyone has tackled that problem in this manner.

In the present method of evaluating the quality factor of a machine the results depend on the Ideal chosen. To illustrate my point. Taking the bomb-load of heavy bombers. The two machines compared have a maximum load of, say, 10,000 lb. and 15,000 lb. respectively. Assuming the "Ideal" to be 20,000 lb., which seems to be about the maximum so far carried, the respective values are 50 per cent. and 75 per cent., giving a difference of 25 per cent. If the "Ideal" is 30,000 lb., in order to incorporate new aircraft not yet used operationally, the values become 33 per cent. and 50 per cent. the difference 17 per cent. This as applied to all factors may make a difference in the total result.

My idea is, instead of comparing the aircraft considered indirectly through means of a hypothetical "Ideal," compare them directly against each other. As an example, I will give a general comparison between the Spitfire V, the Mustang I and the Me. 109F as medium altitude fighters. First, the comparison table:

	Spitfire V	Mustang I	Me. 109F
Speed	369	370	371
Climb	2,600 (1)	2,000 (1)	3,300
Wing-loading ..	26	32.5	35
Endurance ..	1.5 (1)	1.65	1.5
Firepower ..	1,572	2,345	720
Horse-power ..	1,300	1,150	1,150

Just two notes: I have included wingloading as a manoeuvrability factor, but it is interesting to note that the Fw. 190, with a loading of 42 lb./sq. ft., is highly manoeuvrable; (1) denotes my own estimate; Endurance is for 310 m.p.h.; Fire power is in m.h.p.; Horsepower is included as an economy factor.

Secondly, I have not included the maintenance, production or vulnerability factors, because I have not enough information on these points concerning these aircraft.

Now the actual comparisons: In wing loading and horse power reciprocals are obviously compared.

Spitfire: Speed: compared with Mustang, $\frac{369}{370} = 1$

Speed: compared with Me. 109 $\frac{369}{371} = 1$ average 1

Climb: compared with Mustang $\frac{2,600}{2,000} = 1.3$

Climb: compared with Me. $\frac{2,600}{3,300} = 0.8$ average 1.05

Similarly, Wing loading: 1.2, 1.4 av. 1.3
Endurance: 0.9, 1.07 av. 0.95
Fire power: 0.7, 2.2 av. 1.45
Horse power: 0.89, 0.89 av. 0.89
Total average: 1.11

Similarly: the factor for the Mustang is 1.18.
that for the Me. 109 is 0.93.

The Mustang is shown here as the best, but no account has been taken of the fact that the Mustang operates best at about 8,000ft. below the Spitfire's best height.

I have one more comment to make: In the maintenance assessment, Mr. Masefield gives metal-stressed skin 5 pts., and metal fabric covered only 2 pts. Well, surely a rigid metal frame with fabric or some other non-stressed covering is both easier to construct and maintain than a monocoque structure

CORRESPONDENCE

although the latter is lighter in weight and gives better aerodynamic shape. I think the assessment of points for this and the vulnerability factor needs very careful investigation.

F. J. HEYMANN.

[An article on this subject appears on pp. 202-203.—ED.]

JET PROPULSION OF AIRCRAFT

Correspondent in Hot Water

MAY I point out that the suggestion of your correspondent, H. Munday, of using water as a fuel, contains a basic fallacy. He suggests electrolysing the water into its component parts, hydrogen and oxygen, and then burning the hydrogen in the oxygen, and diverting some of the energy produced to decompose more water, and so on.

Now when water is decomposed, electrical energy is used, and if the hydrogen and oxygen so formed are recombined by burning, exactly the same amount of energy will appear as heat as was used to electrolyse the water. If, then, you divert enough energy to decompose more water at the same rate as before, you will have to use *all* the energy and convert it into electricity at 100 per cent. efficiency. This is not a practical possibility, but even if it were, there would be no energy left over to propel the aircraft.

If, as your correspondent suggests, you use some of the heat to turn water into steam, there will be even less energy available to electrolyse the water, and the system will be even more impossible of working.

In any case, since the product of burning hydrogen in oxygen is water, it will be seen that, if the system works, it will be producing hot water at the same rate as we are supplying it with cold water. Since there is no external source of energy, this is impossible, and, therefore, the system will not work.

D. HANSTEAD.

Plea for Further Enlightenment

MAY I now make a definite appeal for an article by Mr. G. Smith or other unimpeachable authority on jet propulsion. There seems to be so much loose thinking about this subject, due, no doubt, to attempts at over-simplification, or else to mischievous leg-pulls.

I cannot follow Mr. Haviland's statements in your issue of February 10th, unless they are intended to provoke argument by deliberate misstatement—a method I have used effectively when in search of enlightenment.

May I deal with his points seriatim?

Fluid flow can only take place from a region of higher to a region of lower pressure; jets or turbine nozzles are no exception. Mr. Burgess's authoritative and informing letter shows that, in vacua, the analogy of the gun is correct during the period of acceleration. The speed of the gun, or rocket, has no bearing upon the value of the thrust in these conditions, and the jet efficiency remains constant irrespective of the speed.

I cannot imagine why Mr. Haviland introduces "g" into an expression already containing mass. Perhaps it is this that causes him to deduce that a device which is doing no work can have an efficiency of 100 per cent., or even more. Would that this were true! Perhaps a definition of jet efficiency ought to be established so that all of your correspondents can meet on common ground. To me—and I venture to believe, to most engineers—it will include first, thrust, time, and pounds of fuel, then relative velocities, density, and viscosity of the medium in which travel takes place. It is simpler if the velocities are reckoned relative to the jet, and not considered in relation to the ground.

Theoretically, jet propulsion can be made more efficient than an airscrew by the use of all the waste heat to increase the slip speed, as indicated by Mr. Shoham, even at airscrew speeds, and in addition it has the advantages which Mr. Haviland so rightly claims, particularly that of increased power/weight ratio, although at the cost of higher specific fuel consumption.

To support my request that velocities be considered relative to the jet, take the hypothetical case of the machine gun on frictionless wheels in a vacuum, firing bullets with a muzzle velocity of 2,000 ft./sec. At the start an observer on the ground would see the bullet travelling at 2,000 ft./sec. away from the gun. When the M.G. has attained a velocity of 2,000 ft./sec. the observer sees the bullet drop out of the muzzle, and when the velocity is 4,000 ft./sec. the bullet is seen to be following the gun at 2,000 ft./sec.—how confusing for the observer! Far better if he travels with the gun and only has to deal with a constant slip speed of 2,000 ft./sec., a constant thrust for a constant expenditure of explosive fuel, and therefore, a constant jet efficiency, at any rate so long as he doesn't reach velocities high enough to bring Einstein into the argument.

"PROJET."

Movement from Unbalanced Pressure

SURELY the aircraft could (all things being equal) be propelled by the impulsive forces created by the sudden release of gases into a total *vacuum*, similar to a rocket. A toy balloon filled with air or gas, if placed in a vacuum and punctured, will travel in a direction opposite the puncture, this movement being due entirely to the unbalanced pressure of gas, or air, on the side unpunctured. Obviously in a vacuum outside forces are non-existent.

L. STUART WATTS, A.M.I.Struct.E., A.M.I.C.D.

[Mr. Stuart Watts' reasoning is sound. In connection with the general controversy as to whether the jet "pushes" or reacts on the atmosphere, it is desirable to make it clear that the jet reacts on the *aircraft* and not on the atmosphere.—ED.]

The Same Old Mistake!

MAY I comment upon the letter of your correspondent E. H. Miles in your issue of February 3rd advocating the "orange-pip principle" for jet propulsion.

First of all, may I ask where the air intake to the compressor and turbine is situated, or is this proposed aircraft self-contained, being of the rocket propulsion type?

Secondly and more important, Mr. Miles says: ". . . have several jets coming out of the shoulders, pressing air against and all round the fuselage, when the aircraft will shoot forward twice as quickly on only half the power." Surely Mr. Miles is making the same age-old mistake made by Mr. E. Colston Shepherd in his broadcast on January 7th, giving the impression that propulsive effort is obtained by the action of the exhaust gases "pushing upon the atmosphere." Apart from this it would seem that the principle would not apply, for the "squeezing" force is moving with the aircraft and is not stationary as the fingers are when shooting an orange-pip.

"ASTRO-AERONAUT."

THE CIRCULATION THEORY

A Useful Mathematical Abstraction

I THINK the best answer to "Engineer's" question in *Flight* of January 27th *re* the existence of circulation is that it is a mathematical abstraction, in the sense that it is one of the components into which the actual motion may arbitrarily be divided. An obvious, though admittedly not a good, analogy is that of a motor car wheel as viewed from the road; no point on the wheel "circulates," in the sense of completing a circuit and arriving back at its starting point, yet the rotary component is the most striking feature of the motion.

Somewhat similarly, to speak of circulation round an aerofoil does not imply that any particle of air makes a tour round it and arrives back at its starting point, though, for the benefit of eager critics, it may be mentioned that individual molecules probably do quite often achieve this feat. That, however, has nothing to do with circulation theory. The point is that the theory starts with a figment of imagination, namely, an inviscid, incompressible fluid capable of following any contours, regardless of the extremes of velocity and pressure that may result. In such a case the calculated flow past an aerofoil inclined to the stream divides just under the leading edge and unites on the upper surface just in front of the trailing edge; there is no lift and no drag, but there is a couple tending to increase incidence.

In reality, of course, the air makes no attempt to get round the trailing edge on to the upper surface, but continues straight on, the junction of upper and lower streams being at the trailing edge. This condition can be produced in the theoretical flow by superimposing a circulation of suitable strength. Since this mathematical trick also predicts a lift nearly equal to the observed lift, it is considered to be well worth while. But physically the lift is still due to the deflection of air downwards, just as it always was. Skin friction is only responsible to the extent that it is the main reason why the air fails to round the trailing edge.

W. E. HICK.

A fighter-bomber Mosquito, with externally hung bombs in place of long-range fuel tanks, takes off for the Continent.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News and Announcements

Appointment

ACT. AIR VICE-MARSHAL A. H. WANN has been appointed Air Officer Commanding, Royal Air Force, Malta. He succeeds Air Marshal Sir KEITH R. PARK, K.B.E., C.B., D.F.C., who was recently appointed A.O.C.-in-C., R.A.F., Middle East.

Air Vice-Marshal Wann went to France with the Advanced Air Striking Force, in which he commanded a Fairey Battle bomber wing. On the collapse of France he was appointed to a command in Northern Ireland and, early in 1941, he became senior staff officer of Fighter Command. While there he qualified, in his spare time, as a Spitfire pilot.

He is one of the airship pioneers of the R.A.F. and commanded the airships R.26 and R.38. He was in command of the R.38 when she broke her back over the Humber in 1921 and crashed in flames. He was the only man saved from the inferno of the ill-fated ship.

Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallantry and devotion to duty in the execution of air operations:—

Distinguished Service Order

Act. Wing Cdr. R. MCFARLANE, D.F.C., R.A.F.V.R., No. 50 Sqn.—This officer has commanded the squadron since July, 1943, and has shown exceptional powers of leadership. He has done much to raise the standard of operational efficiency to a high level, which has been accomplished by the emulation of his own personal example. Wing Cdr. McFarlane is now serving in his second tour of operational duty and has taken part in attacks on most of the enemy's heavily defended objectives. His sterling services are worthy of high praise.

Act. Sqn. Ldr. S. BAKER, D.F.C., R.A.F.V.R., No. 7 Sqn.—Since the award of the D.F.C., this officer has completed a large number of operational missions, many of them in a most responsible role. He has a fine operational record and his ability and devotion to duty have at all times been highly commendable. Sqn. Ldr. Baker has taken part in most of the recent attacks against such targets as Hanover, Leipzig, and Berlin, and as flight commander his leadership and co-operation have been of the utmost value to his squadron.

Act. Sqn. Ldr. D. M. BALME, D.F.C., R.A.F.V.R., No. 207 Sqn.—Since the award of the D.F.C. this officer has continued to set the highest example of bravery and devotion to duty. He has attacked targets in the Ruhr area and in Berlin, with outstanding success, and has also completed missions to other distant and difficult objectives. As a flight commander, Sqn. Ldr. Balme has been unsparing in his efforts to train his crews to the highest degree of efficiency.

Act. Sqn. Ldr. C. F. CAMPBELL, D.F.C., R.A.F.V.R., No. 109 Sqn.—Sqn. Ldr. Campbell has been engaged on operational work which has demanded great skill. His appreciation of the responsibilities with which he has been entrusted, combined with his great determination to complete his tasks, have contributed much to the successes of operations in which he has participated.

Act. Sqn. Ldr. B. H. D. FOSTER, D.F.C., R.A.F.V.R., No. 7 Sqn.—Since being awarded the D.F.C., this officer has successfully bombed some of the most heavily defended targets in enemy territory. His coolness, determination and courage have been of the highest order. An excellent captain of aircraft, he has consistently pressed home his attacks with the utmost vigour, and has frequently, without hesitation, made several runs over the target to ensure accuracy of aim.

Act. Sqn. Ldr. E. H. O'NEILL, D.F.C., R.A.F., No. 109 Sqn.—Since he was awarded the D.F.C., Sqn. Ldr. O'Neill has completed many operational sorties against some of Germany's most heavily defended targets. The great success he has achieved, despite many difficulties, has been due to his courage, determination and skill.

Act. Sqn. Ldr. J. VIVIAN, D.F.C., R.A.F.V.R., No. 57 Sqn.—Now on his second tour of operational duty, Sqn. Ldr. Vivian's work, both in the air and on the ground, has always been of a high order. He has attacked such heavily defended targets as Berlin, Hanover, Kassel, and Dusseldorf. One night in August, 1943, when detailed for an operation against Leipzig, despite adverse weather, he continued to the target and completed a successful attack. Both as a flight commander and captain of aircraft, this navigator has set a high standard of courage and devotion to duty.

W/O. E. S. Ellis, No. 625 Squadron, who has been awarded the Conspicuous Gallantry Medal.

Bar to Distinguished Flying Cross

Act. Wing Cdr. F. G. WOODWARD, D.F.C., R.A.F.O.—Wing Cdr. Woodward has completed two tours of operations against the chief targets in Germany and occupied territory, during which he has displayed courage and determination of a high order. In January, 1943, when attacking Berlin, he remained over the defences for 30 minutes to ensure accuracy of aim. On two other occasions he made gallant efforts to complete his mission, although severely handicapped by engine trouble.

Act. Sqn. Ldr. E. A. BENJAMIN, D.F.C., R.A.F.V.R., No. 61 Sqn.—As captain of aircraft Sqn. Ldr. Benjamin has taken part in many operational sorties and since being awarded the D.F.C. has attacked some of the enemy's most important targets, including Berlin. An excellent flight commander, his courage and skill in the face of the enemy have been most praiseworthy.

Act. Sqn. Ldr. C. J. A. G. BRAIN, D.F.C., R.A.F.O., No. 9 Sqn.—This captain of aircraft, now on his second tour of operational duty, has completed many sorties, during which he has always shown the greatest keenness and determination, pressing home his attacks against some of the most heavily defended targets in Germany. On a recent occasion, undeterred by the failure of one of the engines of his aircraft before reaching the enemy coast, Sqn. Ldr. Brain flew on and successfully completed his mission.

Act. Sqn. Ldr. M. CROCKER, D.F.C., R.A.F.V.R., No. 630 Sqn.—This officer since being awarded the D.F.C. has continued to show skill, determination and courage in the attacks he has made against many strongly defended German targets. As squadron commander his work, both in the air and on the ground, has been of a high order.

Act. Sqn. Ldr. C. M. EVENSON, D.F.C.,

SERVICE AVIATION

R.A.F.V.R., No. 156 Sqn.—Sqn. Ldr. Everson has completed a large number of operational sorties, and since being awarded the D.F.C. has taken part in many further attacks against heavily defended targets in Germany and enemy-occupied territory. As squadron gunnery leader he has displayed organising and instructional ability of a high order, while his efficiency and devotion to duty when in action have been an inspiring example to the air gunners in his squadron.

Act. Sqn. Ldr. W. G. MANIFOLD, D.F.C., R.A.A.F., No. 156 Sqn.—Since being awarded the D.F.C. this officer has taken part in many operations against some of the enemy's most heavily defended targets, consistently pressing home his attacks with great determination. An excellent pilot and captain, his courage and devotion to duty have always been worthy of the highest praise.

Act. Sqn. Ldr. W. F. PARKS, D.F.C., R.C.A.F., No. 50 Sqn.—Sqn. Ldr. Parks, now on his second tour of operational duty, has taken part in attacks on most of the principal German and Italian targets. In June, 1943, during an attack on Gelsenkirchen, his aircraft was attacked by a Me 109, which was probably destroyed. An excellent captain of aircraft and flight commander, this officer's work, both in the air and on the ground, has been of a high standard, while his cool courage in the face of the enemy has been an inspiring example to all.

Distinguished Flying Cross

P/O. K. H. DEMPSTER, R.A.F.V.R., No. 10 Sqn.
Act. Sqn. Ldr. G. CRAWFORD, A.F.C., R.A.F.V.R., No. 55 Sqn.
Act. Flt. Lt. A. J. S. HODSON, R.A.F.V.R., No. 76 Sqn.
Act. Flt. Lt. G. F. TURNER, R.A.F.V.R., No. 76 Sqn.
Capt. P. D. BEVANT, S.A.A.F., No. 2 (S.A.A.F.) Sqn.
F/O. B. J. BEARE, R.C.A.F., No. 227 Sqn.
F/O. H. D. ROBB, R.A.F.V.R., No. 76 Sqn.
Act. W/O. S. A. LUYK, R.N.Z.A.F., No. 90 Sqn.
Act. Flt. Lt. D. A. MACDONALD, R.C.A.F., No. 630 Sqn.
Act. Flt. Lt. L. KILVINGTON, R.A.A.F., No. 156 Sqn.
Lt. D. G. WOOD, S.A.A.F., No. 21 (S.A.A.F.) Sqn.
P/O. R. K. METHERAL, R.C.A.F., No. 419 (R.C.A.F.) Sqn.
P/O. G. P. R. BOND, R.A.F.V.R., No. 156 Sqn.
P/O. S. H. MOON, R.N.Z.A.F., No. 156 Sqn.
Act. Sqn. Ldr. W. K. DAVISON, R.A.F.V.R.
Act. Sqn. Ldr. W. DRING, R.A.F.V.R., No. 185 Sqn.
Act. Sqn. Ldr. P. G. THORNTON-BROWN, No. 609 Sqn.
F/O. A. BRADSHAW, R.A.F.V.R., No. 129 Sqn.
P/O. W. D. JONES, No. 85 Sqn.
Sqn. Ldr. W. D. L. FILSON-YOUNG, R.A.F.O., No. 254 Sqn.
Act. Sqn. Ldr. E. D. OSBORN, R.A.F.O., No. 502 Sqn.
Flt. Lt. S. V. ASH, R.A.F.V.R., No. 236 Sqn.
Flt. Lt. T. M. CUMBERLAND, R.A.F.V.R., No. 455 (R.A.A.F.) Sqn.
Flt. Lt. A. H. EVANS, R.A.F.V.R., No. 178 Sqn.
Flt. Lt. G. L. HATHERLY, R.A.F.V.R., No. 120 Sqn.
Flt. Lt. G. F. HODDER, R.A.F., No. 139 Sqn.
Act. Flt. Lt. R. J. INGRAM, R.A.A.F., No. 11 Sqn.
Flt. Lt. L. M. JEFFREYS, R.A.A.F., No. 455 (R.A.A.F.) Sqn.
Flt. Lt. K. A. H. LAWRENCE, R.A.F.O., No. 15 Sqn.
Flt. Lt. J. H. PORTUS, R.A.A.F., No. 10 (R.A.A.F.) Sqn.
Flt. Lt. H. B. STEPHENS, R.A.F.V.R., No. 109 Sqn.
Act. Flt. Lt. B. ASSON, R.A.F., No. 44 Sqn.
Act. Flt. Lt. D. A. BARRETT, R.A.F., No. 44 Sqn.
Act. Flt. Lt. C. F. BEDELL, R.A.F.V.R., No. 83 Sqn.
Act. Flt. Lt. B. BURNLEY, R.A.A.F., No. 11 Sqn.
Act. Flt. Lt. A. CAREY, R.N.Z.A.F., No. 102 Sqn.

Distinguished Flying Medal

Flt. Sgt. N. G. EMERY, R.A.F.V.R., No. 35 Sqn.
Flt. Sgt. A. FRANCISCONE, R.C.A.F., No. 100 Sqn.
Flt. Sgt. J. E. HEATH, R.A.F.V.R., No. 50 Sqn.
Flt. Sgt. A. W. HICKS, R.A.F.V.R., No. 83 Sqn.
Flt. Sgt. J. B. HUGHES, R.A.F.V.R., No. 57 Sqn.
Flt. Sgt. J. G. JEANS, R.A.F.V.R., No. 120 Sqn.
Flt. Sgt. G. JOHN, R.A.F.V.R., No. 279 Sqn.
Flt. Sgt. (now P/O.) C. M. MANNING, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
Flt. Sgt. W. R. MITCHELL, R.A.F.V.R., No. 12 Sqn.
Flt. Sgt. E. MOORE, R.A.F.V.R., No. 105 Sqn.
Flt. Sgt. I. V. MURRAY, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
Sgt. H. CHEW, R.A.F.V.R., No. 179 Sqn.
Sgt. L. MITCHELL, R.A.F.V.R., No. 179 Sqn.
Flt. Sgt. G. MARLOW, R.A.F.V.R., No. 51 Sqn.
Sgt. T. C. SOLOMAN, No. 51 Sqn.
Flt. Sgt. W. J. WILSON, R.A.F., No. 158 Sqn.
Sgt. L. W. CHAPMAN, No. 244 Sqn.
Sgt. D. G. CREE, R.A.F.V.R., No. 158 Sqn.
Sgt. J. PRINGLE, R.A.F.V.R., No. 158 Sqn.

THE KING has been graciously pleased to approve the following award:—

Air Force Cross

F/O. S. THOMPSON, R.A.F.V.R.

Foreign Decorations

THE KING has granted unrestricted permission for the wearing of the undermentioned decorations conferred upon the personnel indicated, in recognition of valuable services rendered in connection with the war:—

Conferred by the Belgian Government

Croix de Guerre, Belge, 1940

W/O. (now P/O.) F. E. HOGG, D.F.C., R.N.Z.A.F.
Flt. Sgt. J. H. P. HIGGINS, R.C.A.F.

Conferred by the President of the Republic of Poland

Virtuti Military (Silver Cross)

Act. Wing Cdr. A. H. C. BOXER, D.F.C., R.A.F.

Cross of Valour (Krzyz Walecznych)

Act. Wing Cdr. R. C. HOCKEY, D.S.O., D.F.C., R.A.F.V.R.
F/O. R. W. MACMILLAN, D.F.C., R.A.F.V.R.
F/O. E. J. RENVOIZE, R.A.F.
F/O. J. E. MARCH, R.A.F.
Sgt. G. EVANS, R.A.F.V.R.

Air Chief Marshal Sir Sholto Douglas, now A.O.C. in C. Coastal Command, talking to Wing Cdr. A. E. Clouston, D.F.C., A.F.C. and Bar, during a visit to one of the stations in his command.

Cross of Merit in Gold (with Swords)

Act. Sqn. Ldr. L. B. HOBE, M.C., R.A.F.

Conferred by His Majesty the King of Yugoslavia

Order of the White Eagle (with Swords) 1st Class

Air Chief Marshal Sir W. SHOLTO DOUGLAS, K.C.B., M.C., D.F.C., R.A.F.

Roll of Honour

Casualty Communique No. 347.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "On active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 109 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Flt. Sgt. T. R. Davis; F/O. C. G. Hinton; Sgt. W. E. Jones; Sgt. T. G. McDermott; Flt. Sgt. B. J. Pitman; P/O. N. J. Robinson; Sgt. R. G. Taylor; Flt. Sgt. M. G. Valentine.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. L. Arscell; Sgt. W. F. Bradley; Sgt. J. M. Carroll; F/O. F. A. Clark; P/O. G. D. Cockbone; Sgt. E. N. Cummings; F/O. K. I. Dexter; P/O. P. J. Dunger; P/O. C. B. Fleming; Flt. Sgt. J. G. W. Foster; Sgt. G. Glover; Sgt. R. A. Heslop; Sgt. A. E. McWilliams; Sgt. A. B. Magill; Sgt. R. Metcalfe; Sgt. J. T. Murray; Sqn. Ldr. D. G. Ogilvie, D.F.C.; Sgt. W. A. Pasqual; Sgt. R. C. Ridgway; Sgt. W. T. Shepherd; Sgt. H. Staples; Sgt. H. G. Thomas.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. J. W. Avent; Sgt. P. W. Connel; Flt. Sgt. W. W. Dawson; P/O. J. F. Edwards; Act. Flt. Lt. J. G. Eldridge, D.F.C.; Sgt. D. F. Garzarave; F/O. H. H. Gauntlett; Sgt. J. Gould; Sgt. T. Griffith; Sgt. J. H. Griffiths; Sgt. J. A. Head; Sgt. D. A. Holdsworth; Sgt. E. J. C. Howard; Sgt. J. C. Howie; Sgt. T. W. Hunt; Sgt. A. Jones; Sgt. J. P. Lacy; P/O. W. MacFarlane; Sgt. N. MacLeod; Sgt. J. D. Mahony; Sgt. C. Maltby; Sgt. R. G. Miles; Sgt. T. H. Page; F/O. G. W. Pain, D.F.C.; Flt. Lt. W. J. Parsons; Sgt. J. V. Rees; Sgt. D. H. Rock; P/O. J. F. Sanders; Sgt. A. Smithdale; Act. W/O. G. C. Stafford, D.F.M.; F/O. A. E. Steward; Sgt. L. A. Stimpson; F/O. L. E. Thompson; Sgt. R. H. Wells.

WOUNDED OR INJURED IN ACTION.—Sgt. J. L. Lambert; Sgt. F. W. Preston.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. S. Ainsworth; F/O. E. A. Allliston; Sgt. E. R. Clayton; Flt. Sgt. C. A. Cox; Flt. Sgt. G. R. L. Cunningham; Sgt. R. Curle; F/O. R. F. Denney; Sgt. J. F. Dimond; Flt. Sgt. F. A. C. Efemey; Sgt. E. Evans; Sgt. K. Holt; Sgt. A. J. Kirby; Sgt. T. Lafferty; Sgt. D. P. Lawrence; Sgt. W. Mason; Sgt. M. V. Phillips; Sgt. S. J. Pope; Sgt. S. G. Tarrant.

MISSING.—Flt. Sgt. G. W. Allso; P/O. J. Anderson; Sgt. V. Arnold; F/O. G. L. Ashman; P/O. F. J. Baker; Flt. Sgt. R. H. Banks; Sgt. F. Barrett; Sgt. J. S. Bates; Flt. Lt. G. Belcher; F/O. H. F. C. Bonner; F/O. N. H. Bowring; Flt. Sgt. C. R. Boyd; Sgt. H. J. R. Brookman; Flt. Sgt. G. P. Brown; Flt. Sgt. W. C. Burley; Sgt. B. Carroll; P/O. R. J. Caseley; Sgt. J. H. Chambers; P/O. W. A. Clark; Sgt. G. A. Crowe; Sgt. W. B. Currie; Sgt. J. B. Daniel; Flt. Sgt. I. G. Davies; Flt. Sgt. G. A. Davis, D.F.M.; Sgt. J. M. Day; F/O. F. A. Dell; Sgt. F. P. Domenech; F/O. B. P. Duval; Sgt. R. J. Edwards; Sgt. J. Ford; Sgt. E. W. Graves; Sgt. W. W. B. Hamilton; Sgt. M. Hampson; F/O. E. V. Harley; Sgt. J. F. Harmes; Sgt. J. H. R. Harris; Sgt. E. Hibbert; Sgt. J. D. Hickling; Flt. Sgt. C. M. Holder; P/O. G. C. Holland; Act. Flt. Lt. F. T. Hopps, D.F.C.; Sgt. R. Hughes; Sgt. R. S. Imeson; Sgt. W. P. Johnson; Sgt. C. R. W. Jones; Sgt. R. W. Jones; Sgt. S. Jones; Sgt. J. R. W. Kerner; Sgt. J. G. L'Arcent; Flt. Lt. E. L. Lister; Flt. Sgt. J. C. Lochhead; Flt. Sgt. L. G. K. Lock; Flt. Sgt. P. A. Long; Sgt. A. B. McDonald; F/O. D. P. McLoughlin; P/O. A. Mann; Sgt. S. Martin; Sgt. C. P. Matthews; Sgt. G. Merrill; P/O. J. Miller; Sgt. R. J. Moody; Sgt. D. M. Moore; P/O. R. F. Neil; Flt. Lt. W. F. Newell; Sgt. L. Newey; Sgt. A. G. Norton; Sgt. A. D. Peacock; Sgt. D. E. P. Pearson; Sgt. N. F. Petty; Sgt. J. Phillips; Sgt. R. P. Prothero; Flt. Sgt. J. G. Redfern; P/O. D. A. Richardson; Flt. Sgt. J. Richmond; Flt. Sgt. T. J. Robertson; F/O. J. E. Robson; F/O. T. Rosser; Sgt. A. S. Rushby; Sgt. F. E. Ryder; P/O. A. J. Salvage; Sgt. W. L. Sargent; Sgt. M. J. Shervn; Flt. Sgt. R. R. Steven; F/O. J. Stott; Sgt. G. H. Stubbs; Sgt. R. Thomas; P/O. A. McC. Watson; Flt. Sgt. W. J. H. Webb; Sgt. R. H. Wells; P/O. J. A. Williams; Sgt. J. R. Williams; Sgt. G. Wood; Sgt. K. Wood.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—W/O. M. Campion; Sgt. J. B. Green; P/O. H. Lawson; F/O. D. E. Morris; Flt. Sgt. R. N. Morrison.

KILLED ON ACTIVE SERVICE.—L.A/C. A. F. Blue; L.A.C. J. H. Bolsworth; P/O. J. Burgess; Flt. Lt. J. M. Hartley, D.F.C.; Flt. Sgt. J. A. C. Kennett; F/O. J. F. Lee; A/C2 A. Marjoram; L.A/C. P. C. Marson; Flt. Sgt. F. P. Neil; Sgt. E. Parry; Sgt. J. A. B. Radley; F/O. H. F. McP. Taylor, D.F.C.; L.A/C. T. G. Whiteland.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. F. H. Brough; Flt. Sgt. F. Cave; P/O. E. C. Cole; Sgt. W. J. H. Green; Cpl. F. Horton; Act. Wing Cdr. A. D. Isemonger; Flt. Sgt. E. A. Jeffery; A/C.1 G. McLean; L.A/C. R. A. Mallard; L.A/C. R. T. Manley; A/C.1 A. G. Meaden; Sgt. J. A. Prior; Wing Cdr. G. I. Rees; Cpl. L. J. Trepgiden; Sgt. N. R. Yorke.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. M. Alexander; F/O. V. E. Cleite; L.A/C. L. Thomson.

DIED ON ACTIVE SERVICE.—Cpl. A. J. Boyce; A/C.2 N. C. Hill.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. N. H. R. Hart; F/O. R. B. Meiklejohn; Sgt. D. J. Rae; P/O. J. K. Ridley; Sgt. H. Witte.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. A. Scott.

MISSING.—P/O. A. J. Coleman; Flt. Sgt. A. M. Hollingworth; P/O. L. J. Johnson; Sgt. T. MacL. Judd; Flt. Sgt. F. Knight; Flt. Sgt. C. R. McLaren; Flt. Sgt. W. R. Tinman; P/O. N. J. Veech.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—P/O. A. Pearce.

KILLED ON ACTIVE SERVICE.—P/O. J. G. Johnson.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. G. W. Dalton; F/O. R. P. Davies; P/O. E. G. Dolby, D.F.C.; Flt. Sgt. J. W. Lake; Flt. Sgt. A. J. MacLachan; Flt. Sgt. E. S. Rheaume; Flt. Sgt. E. B. Stevenson; P/O. B. I. Tedford; Sgt. S. Tomyn; W/O. H. A. Tripp; Flt. Sgt. G. C. Wickson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Act. Sqn. Ldr. P. L. I. Archer, D.F.C.; F/O. R. W. Clarke; Flt. Sgt. A. R. Currie; Sgt. K. E. Emmons; Flt. Sgt. J. O. Hills; Flt. Sgt. J. Y. Houston; Flt. Sgt. R. H. King; Sgt. G. E. J. Lebihan; F/O. G. B. MacLean; Flt. Sgt. J. S. Marshall; F/O. G. B. Milner; Act. W/O. R. B. Moulton; F/O. J. W. Richardson; P/O. W. A. Sneath; Flt. Sgt. J. J. Stefanchuk; P/O. A. J. Sutton; Flt. Sgt. A. R. Twiss; P/O. E. R. Vance; F/O. W. Wahl; P/O. G. S. Wilson.

WOUNDED OR INJURED IN ACTION.—P/O. D. E. Curren.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. N. T. Anderson; F/O. A. W. Edgar; P/O. F. W. B. G. Hingston; Flt. Sgt. J. A. W. McKenzie; Sgt. A. Wolkowski; Flt. Sgt. H. R. Wright.

MISSING.—Flt. Sgt. G. W. Acorn; P/O. G. H. Armstrong; Flt. Sgt. R. E. Black; W/O. W. R. K. Boles; Sgt. F. L. Brisco; P/O. J. L. E. Cabana; Flt. Sgt. W. R. Clarke; Sqn. Ldr. R. G. Cook, D.F.C.; P/O. J. T. E. Cumming Bart; Flt. Sgt. W. R. Farrell; Flt. Sgt. D. G. Hamilton; F/O. W. E. Hampton; Sgt. G. Heider; P/O. A. T. Hook; Sgt. G. R. Hooper; P/O. G. H. Kay; Sgt. H. A. Keast; P/O. S. R. Kelso; Sgt. J. B. L. Legault; Flt. Sgt. I. M. Lowe; Flt. Sgt. F. C. McCubbin; Flt. Sgt. F. T. A. McKernan; Flt. Sgt. J. E. Marchant; Flt. Sgt. D. W. Milliken; Flt. Sgt. F. P. Morro; Flt. Sgt. J. R. E. Nankan; P/O. W. P. Neale; Sgt. W. J. Rattigan; F/O. L. R. Rinn; Flt. Sgt. R. W. Ritchie; P/O. F. J. Roberts; P/O. H. M. Schade; P/O. M. C. Shaw; F/O. M. V. Snow; P/O. H. V. Stinson; Flt. Sgt. W. K. Sutherland; Flt. Sgt. B. Thomasberg; F/O. R. T. Waddington; Sgt. J. Williamson.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—W/O. J. E. R. Boudreault; Flt. Lt. D. J. Dolphin.

KILLED ON ACTIVE SERVICE.—L.A/C. A. T. Barnson; W/O. C. T. Flack.

DIED ON ACTIVE SERVICE.—L.A/C. R. A. Cimenhage.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. C. H. G. Rodwood.

MISSING.—Flt. Sgt. V. N. W. Turner.

South African Air Force

KILLED IN ACTION.—Flt. Sgt. G. S. Du Plessis; Lt. F. W. Hunning; Lt. I. F. D. Robertson.

KILLED ON ACTIVE SERVICE.—2/Lt. P. G. Locker.

Casualty Communique No. 348

Of the names in this list, 115 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—F/O. H. H. Garment; Flt. Sgt. G. F. Handel; Flt. Sgt. A. H. Severn; W/O. R. B. Smith; F/O. T. Sowerbutts.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. H. Alexander; Sgt. A. C. Beddoe; Sgt. M. H. Burston; Act. Flt. Lt. W. T. Christie, D.S.O., D.F.M.; Sgt. E. S. Coster; Sgt. W. George; Sgt. G. Hull; Sgt. G. G. Kitson; F/O. V. R. Matthews; Sgt. A. D. Pain; Sgt. G. A. Robinson; P/O. C. Strand; Sgt. C. K. Surgey.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. J. G. Adam; Flt. Sgt. S. Adams; Sgt. J. H. Aspden; Sgt. F. N. Barley; Flt. Sgt. J. A. P. Bartlett; Sgt. C. Birtles; Sqn. Ldr. W. A. Blake; Sgt. E. A. Bogle; F/O. A. V. Bone; P/O. G. A. Bozier; Sgt. J. E. Boyes; P/O. S. W. Brooke-Norris; Flt. Sgt. G. Brown; Sgt. A. W. Chapman; Sgt. R. J. Cook; Sgt. E. W. Cosnett; P/O. P. C. Cotter; Sgt. R. Coulson; Sgt. R. F. Coverdale; Sgt. S. E. Crooks; Sgt. G. H. Cruxton; Sgt. L. Denby; Flt. Sgt. D. B. Dray; W/O. J. G. Edwards; F/O. H. Elderfield; F/O. E. H. Ferguson; Sgt. R. N. P. Foster; Act. Sqn. Ldr. R. A. D. Foster; P/O. R. H. Genesis, D.F.M.; Sgt. M. R. Hadland; F/O. P. Harvey; Act. Flt. Lt. D. H. Haycock; Flt. Sgt. A. Hill; Sgt. H. Hinchcliffe; F/O. F. J. Hudson; Flt. Lt. A. H. Hull; P/O. S. Hunter; Sgt. W. A. W. Hunter; Sgt. A. H. Jeffery; Sgt. J. Kay; P/O. A. D. Kitchen; Sgt. S. J. Knight; Sgt. R. W. Lambert; Sgt. J. Leadbetter; Sgt. J. Lees; Flt. Lt. J. H. Loder, D.F.C.; P/O. B. McKeon; Sgt. P. E. Matthews; Sgt. R. J. Matthews; Sgt. M. W. Moore; P/O. I. M. P. Morgan; Sgt. A. McK. Munn; Sgt. R. A. Nason; Sgt. J. J. O'Hagan; P/O. F. Oliver; P/O. W. J. Painter; Sgt. C. J. Percival; Sgt. L. Pickford; Sgt. C. T. Price; Sgt. A. H. Radbourne; P/O. G. A. Ratcliffe; Sgt. G. E. Roberts; P/O. G. Russel; P/O. T. J. Ryder; P/O. J. Smart; Act. Sqn. Ldr. T. Smart, D.F.C.; Sgt. R. W. Stockton; P/O. F. A. Terry; Sgt. E. Thomas; Sgt. J. Thurlow; F/O. L. Walters; Sgt. R. E. Watson; Sgt. H. R. B. Whyatt; Sgt. R. F. Wilson; P/O. H. T. Wookbridge; Sgt. J. Wright; Act. Flt. Lt. P. B. Wright, D.F.C.; Sgt. C. W. Yelland.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. S. H. Benjamin.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. H. N. Pepper.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. R. A. Boothman; Sgt. M. Boylan; Sgt. A. G. Cole; Flt. Sgt. G. F. Cornish; Sgt. R. S. Dalton; Sgt. N. E. Davis; P/O. J. Earle; W/O. J. F. Gillhespy; Flt. Sgt. R. G. Howell; P/O. R. S. Jones; Sgt. O. V. Kent; Sgt. C. W. Phillips; W/O. R. Reid; Sgt. A. W. Richardson; Sgt. B. Robinson; Flt. Sgt. T. J. Russell.

MISSING.—Sgt. W. Ainscrow; Flt. Sgt. R. J. Argent; L.A/C. C. F. Ashby; P/O. C. H. Bayman; Sgt. D. J. Bealey; Flt. Sgt. M. W. Biles; Barford; Sgt. D. W. Blackman; P/O. A. H. Blackmore; W/O. K. L. O. Blow; Sgt. P. W. Booth; F/O. R. S. Bowden; Sgt. T. C. Bramley; F/O. A. E. Busby; Sgt. K. R. Butcher; P/O. D. E. Cake; Flt. Sgt. B. E. Caton; Sgt. W. E. Cawal; Flt. Sgt. S. P. Clark, D.F.M.; Sgt. G. W. Clement; Flt. Sgt. K. J. Coates; Sgt. J. Cockroft; Sgt. W. R. Cox; Sgt. T. S. Daniel; Flt. Sgt. W. R. J. Dingle, D.F.M.; F/O. J. C. Doherty; Sgt. A. W. Dowsett, D.F.M.; F/O. H. W. Duckitt; Flt. Sgt. H. T. Evans; Sgt. H. Fox; F/O. M. L. B. Frankson; Sgt. J. W. Garland; Flt. Sgt. K. Hawkins; Sgt. R. W. Hayes; Sgt. J. Heron; Sgt. C. Hubbert; Sgt. D. Hudson; L.A/C. W. W. Hutchings; F/O. T. H. Jackson; F/O. R. W. Johnson; Flt. Sgt. G. W. Jones; Sgt. A. L. Joynson; F/O. E. L. J. Key; Sgt. R. H. Kibby; Sgt. G. S. Lawn; Sgt. G. Leggott; Sgt. J. E. McColley; Flt. Sgt. J. H. McWilliams; Flt. Sgt. T. Mair; P/O. H. Matthews; Flt. Sgt. L. R. B. Matthews; Sgt. L. R. Miles; Flt. Sgt. L. V. Murrell; Flt. Sgt. R. C. Nash; Sgt. W. G. Neale; Sgt. E. North; Flt. Sgt. K. E. Payne; Flt. Lt. R. Pearson; Flt. Sgt. V. D. Perry; Flt. Sgt. I. J. Phipps; Act. Flt. Lt. C. P. Ready; Sgt. P. R. Redbourne; Sgt. R. C. Rigg; Flt. Sgt. W. A. Robertson; Sgt. A. D. Roulson; Flt. Lt. L. N. Row; Sgt. B. J. Saville; Sgt. F. F. Scott; Sgt. F. G. Selby; P/O. W. McC. Sinclair; Flt. Sgt. L. G. Slaughter; Sgt. J. McL. Stewart; Sgt. K. Swinchatt; W/O. F. Turvil; F/O. A. J. Wakefield; P/O. F. J. T. Walker; Sgt. A. E. Watkins, Sgt. R. W. Webb; Sgt. S. Williams.

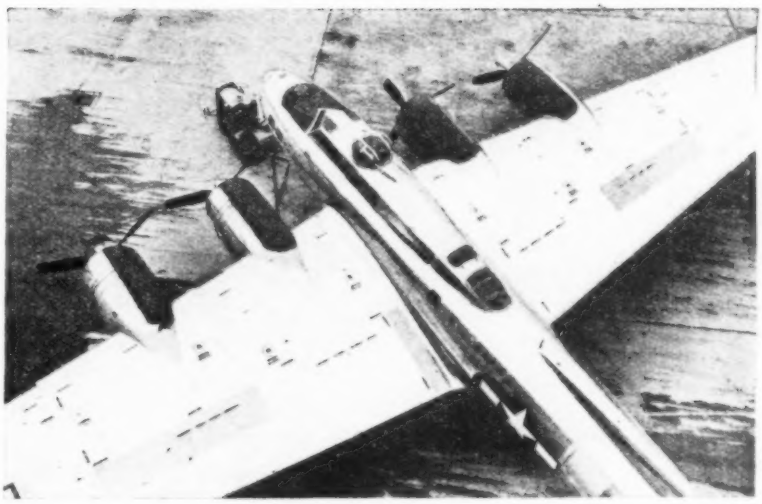
KILLED ON ACTIVE SERVICE.—Flt. Sgt. J. W. Boilstone; Sgt. E. W. Brown; Flt. Sgt. R. V. H. Brown; P/O. R. L. Church; P/O. P. S. Cobb; L.A/C. H. Hyndman; Flt. Lt. H. H. J. Leigh Clare; Sgt. L. R. Mace; Flt. Sgt. A. Merridew; Sqn. Ldr. J. H. Osborne; Flt. Sgt. J. Pengood; Sgt. J. Sage; Sgt. R. L. Sanders; P/O. G. O. Sharpe; Flt. Lt. C. F. H. Wiesner; Sgt. S. Wilson; Sgt. W. Young.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. H. Bloomfield; L.A/C. J. Cockroft; L.A/C. J. Cruse; Sgt. W. M. Hall; L.A/C. J. H. Mitchell; A/C.2 R. R. L. Wilkinson.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. T. Midwinter; Sgt. K. Ward.

DIED ON ACTIVE SERVICE.—L.A/C. T. J. Bamber; Sgt. T. H. Blease; L.A/C. R. Brown; L.A/C. P. H. Clarke; Cpl. R. Clark; Flt. Lt. W. E. Comber; Sgt. L. A. G. Galloway; A/C.1 G. N. C. Gillman; L.A/C. P. H. Green; Flt. Sgt. K. H. Jefferson; L.A/C. G. E. Johnson; F/O. J. S. King; A/C.1 J. Lang; L.A/C. H. H. Lennon; P/O. B. D. Ransom; A/C.2 C. Wilkinson.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED PRISONER OF WAR.—Sgt. D. McI. Miller.



Fortresses are test flown before being finally painted, but the engine nacelles and nose are painted to protect the eyes of the test crews from the glare of the sun.

L.A/CW. I. G. Leask receiving the Legion of Merit medal from Gen. Spaatz. L.A/CW. Leask was instrumental in finding and homing an American air formation which was off its course.

SERVICE AVIATION

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.2 M. C. Andersen; Flt. Officer E. Davidson; L.A/CW. M. L. Woodley.

Royal Australian Air Force

KILLED IN ACTION.—F/O. W. C. C. Edmonds; Flt. Sgt. J. L. Rossiter.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. W. R. Berry.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. D. P. Birk; F/O. J. A. Cox; F/O. W. J. Dennett; F/O. W. E. Emery; F/O. A. C. R. Flashman; P/O. K. S. McColl; Flt. Sgt. D. F. Walker; Flt. Sgt. F. Williams.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. L. J. Purcell.

MISSING, BELIEVED KILLED IN ACTION.—P/O. J. H. J. English; Flt. Sgt. A. E. Kan.

MISSING.—Flt. Lt. W. A. Horsley; P/O. J. L. May; F/O. L. R. Parnell; F/O. L. C. Perry; Flt. Sgt. W. T. C. Styles; P/O. J. Syme; P/O. C. W. Walker.

KILLED ON ACTIVE SERVICE.—F/O. A. G. Addison; Flt. Sgt. N. Doherty; Flt. Sgt. N. C. Grob; F/O. A. H. Salt; F/O. J. B. Selth.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. D. W. W. Bull.

DIED ON ACTIVE SERVICE.—Sgt. L. M. Parber.

Royal Canadian Air Force

KILLED IN ACTION.—P/O. A. E. Boad; W/O. W. E. R. Meehan; W/O. J. H. Yorke.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. H. G. Allen; Flt. Sgt. E. W. Cole; Sgt. J. F. J. McCaw; Flt. Sgt. R. W. MacNeill; F/O. T. J. Marriott; P/O. J. N. Miller; Sgt. J. H. Oliver; P/O. R. C. C. Smith; Flt. Sgt. J. Taylor.

MISSING, BELIEVED KILLED IN ACTION.—W/O. R. Cumming; W/O. I. Roding; W/O. E. J. Walters; F/O. G. H. Weeden.

MISSING.—W/O. T. W. Larkey; Flt. Sgt. D. M. Thorpe; F/O. D. N. Turner.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. W. R. Chester; Sgt. A. W. Ellis; P/O. J. K. Forest; Flt. Sgt. E. F. J. Hemming; Sgt. W. E. Martin; W/O. K. R. Schiller; Flt. Sgt. J. McN. Thomson.

PREVIOUSLY REPORTED MISSING NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. R. W. Harbottle.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. H. Di Domenico; W/O. W. E. Tanner.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. E. F. McKenna; F/O. E. V. Watkins.

MISSING.—F/O. J. R. G. Bathgate; W/O. J. Gartside; Act. Flt. Lt. F. C. R. Mackie; Flt. Sgt. H. J. Millar; P/O. C. B. Muir; P/O. T. A. Robson; Flt. Sgt. R. H. Sinclair; Act. Flt. Lt. J. H. Wright, D.F.C.

KILLED ON ACTIVE SERVICE.—F/O. J. G. Dasent.

South African Air Force

KILLED IN ACTION.—Lt. E. C. Jordan.

MISSING.—Lt. R. E. Laing; 2/Lt. N. M. MacDonald; Lt. L. J. Oates.

KILLED ON ACTIVE SERVICE.—Air Mech. B. L. Watson.

Casualty Communiqué No. 349

OF the names in this list, 106 are second entries giving later information of casualties published in earlier lists

Royal Air Force

KILLED IN ACTION.—Flt. Sgt. A. E. Brown; F/O. W. A. Coison; Sgt. N. M. Cooper; Sgt. R. C. Custance; W/O. H. P. Davis; Sgt. N. N. Griffin; Sgt. J. G. Hayden; Sgt. D. W. Inglis; Act. Sqn. Ldr. D. F. Mackenzie, D.F.C.; F/O. W. F. McMaster, D.F.M.; Sgt. E. A. Maloney; Sgt. L. B. Perry; P/O. J. T. Pratt; F/O. A. M. O. Pring; Sgt. C. C. Reid; Sgt. R. K. Rye; Sgt. E. V. Smith; Sgt. R. W. M. Spelman; Sgt. C. G. Thompson; Sgt. H. A. Williams.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. S. Brown; Sgt. F. J. B. Dukes; F/O. H. Forshaw; Sgt. J. S. W. Fowles; P/O. K. McCulloch; Sgt. N. C. Richards; Sgt. P. J. Ruane; Sgt. L. Timms; Sgt. R. Tofts; P/O. W. M. Young.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. H. I. Ashdown; F/O. E. H. Beeton; Flt. Sgt. M. J. Bennett; Flt. Lt. G. F. Berridge; Sgt. R. Borthwick; Sgt. H. A. Briggs; Sgt. D. W. Brough; F/O. R. V. Cartwright; Sgt. A. Chadwick; Sgt. R. J. Chapman; Flt. Sgt. W. J. Chapple; Sgt. A. J. Cousins; Sgt. E. J. Culley; Sgt. T. W. P. Daniel; Sgt. H. E. Dixon; Flt. Lt. A. P. Dowse, D.F.C.; Sgt. H. Evans; Sgt. D. C. Farley; P/O. W. C. R. Foale; F/O. P. M. Gordon-Crosby; Flt. Sgt. S. Grundy; Sgt. A. Haigh; Sgt. R. S. Hamilton-Fox; Flt. Sgt. F. Hemmings; Sgt. J. Hence; Flt. Sgt. H. V. Holmes; Sgt. D. J. A. Hyde; Sgt. L. A. James; Sgt. W. T. Lee; Sgt. B. Legg; Sgt. C. H. Longley; Sgt. J. S. Lowdell; Sgt. W. C. MacAulay; Sgt. J. McKenny; Sgt. J. Monks; Sgt. D. Montgomery; Sgt. C. S. H. Morley; Sgt. J. Muir; Sgt. B. L. Neal; Flt. Sgt. J. W. Newport; Sgt. W. D. G. O'Brien; Sgt. A. Penlington; P/O. C. B. Perring; Sgt. D. I. Pullen; Sgt. S. Richardson; P/O. R. D. Roberts; Wing Cdr. W. P. Shand, D.F.C.; Sgt. A. Shaw; Sgt. V. G. L. Smith; Sgt. J. Stone; Sgt. V. J. Tarr; Sgt. K. W. Taylor; Sgt. D. W. Thomas; Sgt. W. J. Turpin; Sgt. A. W. Waite; Sgt. D. A. W. Weller; Sgt. V. I. Williams; Sgt. C. A. Willis; Sgt. D. R. Wilson.

WOUNDED OR INJURED IN ACTION.—F/O. V. L. Coals; Sgt. H. Day; Flt. Sgt. K. L. Kirby; Flt. Sgt. R. F. Marshall; Sgt. W. O. Ross.

A Douglas Dauntless drops its load at the bottom of the dive.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. A. H. Bale; Sgt. J. H. F. Cochrane; F/O. A. W. Gadd; Sgt. G. W. Hewitt; Sgt. A. C. Leitch; Sgt. R. V. D. Smith; P/O. R. Stott, D.F.M.

MISSING.—Flt. Sgt. R. J. Banks; F/O. M. Bentley; Sgt. J. L. Blackwood; P/O. J. G. Blandford; Flt. Lt. A. Brown; F/O. I. A. C. Campbell; F/O. H. T. Clarke; Sgt. J. H. Colley; F/O. E. Cotton; Sgt. A. G. R. Cowdrey; Sgt. R. N. P. Critchlow; Sgt. J. B. Croft; Act. Sqn. Ldr. K. B. L. Debenham; F/O. P. J. DeCharmoy; P/O. E. J. H. Downs; Sgt. E. Draper; Sgt. J. H. Flack; Act. Sqn. Ldr. A. Gibson, D.F.C.; Sgt. J. E. Goss; Flt. Sgt. A. H. Hartshorn; Sgt. A. P. Hateley; Sgt. R. Hawkins; Flt. Lt. E. Hebden; P/O. R. A. Hebditch, D.F.M.; Sgt. K. N. Hicklin, D.F.M.; Flt. Sgt. W. C. Higgs; Flt. Lt. T. B. Hughes; F/O. T. W. Jackson-Baker; Sgt. I. Lewis; F/O. I. R. MacDonald; Sgt. S. A. Martin; P/O. S. Mayer; W/O. G. Milner; F/O. E. J. B. Moss; W/O. D. J. Nixon; P/O. A. W. Osborn; Sgt. A. C. I. Phillips; F/O. J. D. Philips; Sgt. G. A. Ray; F/O. B. F. Reynolds; Sgt. J. K. Robertson; F/O. R. J. Scott; Sgt. H. Seatter; Flt. Sgt. C. J. Seery; Flt. Sgt. H. S. Smith; Sgt. H. E. Steele; Flt. Lt. S. A. Tucker; Sgt. R. J. Veitch; Sgt. J. Wadsworth; Sgt. R. G. Whitmarsh; Sgt. F. Wilson; F/O. A. G. Wood; Flt. Sgt. R. E. Woods.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Flt. Sgt. D. H. McRae; Flt. Sgt. L. C. Miller.

KILLED ON ACTIVE SERVICE.—Act. Sqn. Ldr. W. E. Allison, D.F.C.; Flt. Sgt. C. W. Angus; P/O. G. H. Barrett; F/O. E. Bartholomew; Sgt. R. E. C. Battle; Sgt. R. Butfham; F/O. M. J. F. Burge; Sgt. E. Cole; Sgt. J. M. Crossley; Sgt. R. J. W. Dhering; F/O. K. S. Ewins; P/O. T. L. Ford; Sgt. J. E. Graham; Flt. Lt. S. A. Hankey; Wing Cdr. W. A. Hughes; L.A/C. K. Jenkinson; Sgt. G. N. Jones; Flt. Sgt. V. Kearney, D.F.M.; L.A/C. R. Kellett; Flt. Lt. J. McA. McBride; Flt. Sgt. P. Y. Morris; Sgt. J. V. Newton; F/O. H. L. Pugh; A/C.1 L. J. Pugh; A/C.2 G. Renton; Sqn. Ldr. C. Robertson, D.F.C.; F/O. G. A. Rolph; Sgt. W. Rose; Sgt. E. J. Roynon; Sgt. W. Siddoway; Flt. Sgt. F. V. M. Slater; W/O. W. G. R. Sutherland; F/O. F. D. Thomas; W/O. H. Timlin; F/O. R. G. Warmington; A/C.2 G. J. Wood.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. H. P. Clark; Cpl. H. Geary; Sgt. W. R. Hemsley; Sgt. R. A. Mitchell; F/O. S. Thompson; Flt. Lt. W. M. B. Thompson.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. A. J. C. John; L.A/C. T. G. Jones; Cpl. W. Mawson; L.A/C. L. Straughan.

DIED ON ACTIVE SERVICE.—A/C.2 W. H. Barlow; A/C.2 A. J. Bateman; A/C.1 J. J. Bell; L.A/C. H. V. Bembridge; L.A/C. R. T. Christie; Sgt. W. Clarke; L.A. C. C. A. J. Colegate; L.A/C. L. P. Connor; A/C.1 D. W. Davies; L.A/C. J. Fleming; L.A/C. F. N. Fox; L.A/C. N. E. Grainger; L.A/C. J. Gregory; A/C.1 J. Haley; L.A/C. J. Heaton; L.A/C. J. C. Keech; Sgn. Ldr. F. C. Langley; A/C.1 A. C. Potts; Cpl. F. A. Read; L.A/C. B. G. Robins; Sgt. I. E. Shears; Sgt. F. W. Smith; A/C.2 K. White.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—L.A/CW. K. J. Baxter; Assist. S/O. G. Dufton; Sgt. L. E. Griffith; A/CW.2 P. K. Jung; L.A/CW. N. Rosser; L.A/CW. M. S. Titley; A/CW.1 G. K. R. Tolhurst.

Royal Australian Air Force

KILLED IN ACTION.—Flt. Sgt. V. G. Tankard.

MISSING.—Flt. Sgt. G. T. Agg; Flt. Sgt. A. W. B. Barrett; Flt. Sgt. O. E. C. Hoffman; W/O. A. C. Kidson; Flt. Sgt. D. V. Paul; Flt. Sgt. R. M. Simpson.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Flt. Sgt. R. G. N. Barber; F/O. M. A. Stokes.

KILLED ON ACTIVE SERVICE.—P/O. E. H. Gribble; Flt. Sgt. A. J. Smith.

WOUNDED OR INJURED ON ACTIVE SERVICE.—P/O. D. Beardman; P/O. G. R. Bermingham; P/O. J. E. Evans.

Royal Canadian Air Force

KILLED IN ACTION.—W/O. H. S. Fraser.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. L. L. Hamelin.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. D. L. Bain; Sgt. A. J. Burwell; Sgt. G. D. Clune; Sgt. J. A. Corbett; Sgt. R. Dunbar; F/O. E. F. Dynarski; Sgt. W. J. Foley; Sgt. D. A. Forestell; F/O. L. G. Gibson; F/O. L. G. Girty; Flt. Sgt. J. K. Glazebrook; P/O. R. R. Grimes; Sgt. G. R. D. Hall; Sgt. H. A. Healey; F/O. W. S. Large; Sgt. A. B. McDonald; P/O. M. A. MacDonald; Sgt. R. H. May; P/O. E. M. Merritt; Flt. Sgt. C. A. Milan; Sgt. R. C. Milliken; Sgt. C. J. Phelps; P/O. R. J. M. F. Reid; Sgt. J. N. Reigate; Act. Flt. Lt. H. G. Shockley; Sgt. J. A. E. St. Laurent; F/O. R. W. Taylor, D.F.C.; Sgt. C. H. Tidy; Flt. Sgt. R. M. Tooze; Sgt. R. B. Van Buren; F/O. L. McB. Wadman; F/O. R. E. Wesley; F/O. R. J. Wright.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. S. B. Adams.

MISSING, BELIEVED KILLED IN ACTION.—P/O. S. W. F. Baker; F/O. J. F. Bower; Flt. Sgt. J. R. Goodwin; Sgt. W. H. Green; Flt. Lt. H. D. MacDonald, D.F.C.; P/O. R. W. McManaman; Sgt. W. E. Stinson.

MISSING.—F/O. C. T. Clark; F/O. F. J. Gregory; Flt. Sgt. G. P. Lowle; Sgt. J. A. McEwen; Act. Flt. Lt. D. R. Matheson; Flt. Sgt. A. R. Morgan; Flt. Sgt. C. E. Quickfall; Flt. Sgt. A. E. Slegg; P/O. J. A. St. Denis.

KILLED ON ACTIVE SERVICE.—F/O. D. J. Arneil; F/O. G. J. Frost; Flt. Sgt. R. F. Linton; Sgt. R. W. McLachlan; Sgt. D. G. MacNeil; Sgt. W. H. Sayres; F/O. W. D. Smith; F/O. G. A. H. Stevens, D.F.C.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. G. G. Mills.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. E. B. Lindsay.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—F/O. H. E. Pittaway.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Sgt. R. S. Dutka; Flt. Sgt. W. L. McKinnon.

Royal New Zealand Air Force

MISSING.—P/O. N. T. Newton; Act. Flt. Lt. J. R. Petrie, D.F.C.

DIED ON ACTIVE SERVICE.—Flt. Sgt. P. G. Dobson.

South African Air Force

MISSING.—Lt. C. A. E. Chadwick; 2/Lt. J. W. Forrest; Lt. C. G. Heher; 2/Lt. I. D. Murray.

KILLED ON ACTIVE SERVICE.—Lt. D. W. Durpeez.